Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "THE ELECTRICAL ENGINEER."

VOL. XXXV. NEW YORK, SATURDAY, MARCH 3, 1900. No. 9.

PUBLISHED EVERY SATURDAY BY

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

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Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - 6.00
Single Copies, - .10

In requesting your address changed give OLD as well as new address.

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Entered as second-class mail matter at the New York Post Office.

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THE ELECTRIC ARC IN MEDICINE.

Elsewhere will be found an account of the Finsen method of treating certain skin diseases by means of rays of high refrangibility obtained from the arc light. This method of treatment has been extraordinarily successful with lupus, a cutaneous affection sometimes confounded with cancer and which heretofore has frequently baffled the physician's skill. Recently it has been proposed to apply the electric arc in a similar manner to the treatment of consumption, and already claims of success are made. Should these claims be confirmed electricity will have conferred upon humanity a boon even greater than the material ones from its industrial applications.

THE LATEST ERIE DEAL.

The idea that the Erie telephone system might pass into independent telephone hands has already been discussed in these columns, so that the actual news of the completion of such a deal will not greatly surprise any of our readers. The rough details of the acquisition of the Erie properties by the Telephone, Telegraph & Cable Company are given elsewhere in our pages this week.

From the standpoint of the financial magnates who compose the absorbing company, this is a very advantageous purchase, but it leaves a curious and complicated situation, for the biggest independent group at once become the biggest Bell licensees. Just where that will tend no one can say at the moment. The situation is, however, strikingly parallel to that which developed in electric lighting when the Brush and Thomson-Houston companies got together, or when the simon-pure Edison local companies all of a sudden found their interests in the hands of those who had been previously their chief antagonists and the advocates of arc lighting. The growth of independent telephony is one destined, we imagine, to present many elements of dramatic surprise of this character.

PARCEL POST.

The figures of American foreign trade continue to show signs of development and improvement, while our latest statistics of electrical exports prove the field to be widening all the time. One of the needs of the situation is that better opportunity should be afforded for distant customers to ascertain the real merits of American electrical apparatus. Where this apparatus is heavy, it must either be bought on faith or after inspection or on the strength of such articles as appear in our own columns from time to time describing it or illustrating plants in which it is used. The expostion such as that at Paris this year is another but costly method.

There remains the parcels post, which might well be utilized more than it is as a means for distributing the endless variety of smaller electrical goods made in this country all over the world. It is a fact which is not generally appreciated that this country has parcels post treaties with Germany, Chili, Bahamas, Barbadoes, Colombia, Costa, Rica, the Danish West Indies, the Hawaiian Republic, Honduras, Jamaica, Leeward Islands, Mexico, Salvador, British Guiana, Windward Islands, Newfoundland, Trinidad and Guatemala. None of these treaties perhaps amounts to much except that with Germany, but the figures of such business with that country are quite impressive, nearly 17,000 parcels having been exchanged. If such treaties can be effected also with England and her larger colonies and dependencies, with France, Austria, Italy and other countries, the benefits to export trade should be appreciably large. Trade and intercourse are synonyms, and a parcels post is as necessary to both as the mails, steamships and the ocean cable.

Cable Manufacture.

The making and laying of the Pacific cable is one of the most immediate and most important questions before the American public, and, it is needless to say, is a matter of deep interest to all Americans engaged in electrical pursuits. So far as can be seen, this country is in the Philippines, in the Sandwich Islands and in Samoa to stay; and even if that were not so, our growing traffic with the Far East would compel the early creation of better cable facilities. We are glad to believe that an American Pacific cable will soon be laid, and we hope the cable will be of American manufacture.

On the point of home production of the cable, the recent arguments presented to the United States Senate by Messrs. Marsh and Satterlee are most timely and weighty. We trust they will have effect. Only those who are familiar with American cable factories and the quality and quantity of their output, can have an adequate conception of the tremendous growth of that industry in the United States. It is only in the branch of submarine cable work that our factories have been behind; and that is only for the reason that hitherto there has been little call or necessity for such work. But the amount of general cable work of all kinds here is in the aggregate probably as large as that for all Europe, and it is a pardonable inference that given the opportunity for making deep-sea cable in large mileage, our manufacturers will be equal to the occasion. If they are not, the chances are that under a clause requiring the cable to be made in this country, some European manufacturer will find it worth while to transplant himself, a thing which has often happened before in other industries, and which, broadly considered, is not a disadvantage but a gain. We trust that the $8,000,000 estimated as necessary for making the cable will be spent here, and that American shipping will also derive some benefit from the $4,000,000 required for laying the cable.

The Nernst Lamp

In other columns will be found an article giving a brief account of the first commercial application of the Nernst lamp—in Göttingen, Germany, the home of the inventor. The economy of working satisfactorily bears out the claims which have been made, a 25-cp lamp operating on 33 watts, or 1.3 watts per candle-power. This figure corresponds to about double the highest economy toward which the carbon filament incandescent lamp is striving, so that on the showing of economy alone the latter is left hopelessly behind. On the other hand, the type of lamp used at Göttingen will scarcely prove a dangerous rival commercially to the incandescent lamp, notwithstanding its high economy. The incandescent filament lamp has, owing to its enormous convenience, made its way against the gas light, notwithstanding the greater cheapness of the latter, and has little to fear in a rival requiring—not the simple lighting of a match and turning of a key—but the application of an alcohol flame and an expenditure of time to set it in operation. However, the type of lamp described is not the one upon which expectations of a great future for the Nernst lamp have been based, and the writer of the article describes an automatic lamp obviating the objection cited. The interesting points are that even in a crude form the Nernst lamp can be practically applied to commercial lighting, and that its claims for high economy are demonstrated in daily working.

The Steam Turbine.

From the earliest days of the steam engine the reciprocating type of mechanism for transforming the expansive power of steam into mechanical power has been considered far from satisfactory. For this reason the rotary engine for almost a century was one of the favorite subjects for the inventor, and on it mints of money have been expended with no results, owing principally to the insuperable mechanical difficulties encountered with respect to securing steam-tight working joints. Doubtless during this period the turbine principle occurred to many, and doubtless also was dismissed with the thought that the speed of the steam turbine would be beyond the bounds of practicability in application. As this objection has less force in the case of electric generating machinery, it was but natural that during the past fifteen years the development of the steam turbine should be taken up with a view to its utilization in electrical generation. That the development has been slow has resulted in some doubt as to the mechanical and economic capabilities of the machine, but that any such doubts are unfounded will appear to be demonstrated by the results of recent experience.

In another page an account is printed of an English steam turbine electric generating plant, in which the steam turbine makes an extremely good showing with respect to the three vital factors of first cost, space occupied and economy of operation. It will be seen that the cost of the turbine plant with all its auxiliaries was considerably less than the lowest price of any of four steam plants of the usual type with which it was in competition. The showing with respect to the steam consumption is also in favor of the turbine plant, while there is no comparison as to the space occupied and the cost of erection. We learn that the same type of turbine used in the plant referred to will soon be placed on the market in this country, but with many improvements which add very materially to the efficiency of the machine. In some tests recently made, we are informed that a machine driving a 300-kw bipolar alternator showed a steam consumption at full load of but 16.4 pounds per electrical horse-power hour; at half-load 18.2 pounds, and 22 pounds at quarter-load. Owing to the speed of the machine—3600 r. p. m.—the comparatively miniature bipolar generator driven delivers two-phase currents of 60 cycles per second. A machine of the same type is now building for a New York City electric lighting station which will drive a six-pole generator rated at 1500-kw at a speed of 1200 r. p. m., the current being delivered at a frequency of 60 periods per second. Should the promise held out by the cases cited be fulfilled over a sufficient period, it is not prophecy to say that the steam turbine will revolutionize steam practice in electrical generation.

The Institute Standardization Rules.

Some interesting comments upon the report of the Committee on Standardization of the American Institute of Electrical Engineers, (which report was printed in these columns during July and August, 1899), appear in this number, from the pen of Mons. C. F. Guilbert, of Paris. The comments are made in a friendly spirit and the criticisms offered, while well worthy of consideration, are interesting as showing how little of importance there appears to be in the report to arouse hostile sentiment among French engineers.

When we consider that the standardization rules cover practically the whole range of dynamo-electric machinery, and offer suggestions for the determination of the output, rating, and efficiency of such machinery, together with conventions for the definitions of terms previously used loosely in the industry, it will be evident that the opportunities to criticise the results are abundant and ready to the hand of the most casual analyst. It is manifestly impossible that all engineers and manufacturers should be unanimous upon these questions, or the necessity for the existence of such rules would never have arisen. At best, any such set of regulations can only be in the nature of a compromise, and, moreover, in the progress of an industry which is advancing so rapidly as that of electrical engineering, it is not in the nature of events that permanence should attach to any set of definitions or regulations relating to the testing or behavior of electrical machinery. Even if the regulations were absolutely beyond the reach of criticism at the

day on which they were printed, they would necessarily become inadequate and antiquated in the course of time. It is important for this reason to consider all the criticisms that may be offered, with a view to making the best possible amendments in the rules at such times as may make amendments opportune.

The first criticism of M. Guilbert is in the direction of classification of machines. He thinks that a simpler basis of classification would have been better but admits that the classification adopted is scientifically correct. It is evident that this is a question of individual opinion and that no single classification could escape censure in some direction. It is then pointed out that "unipolar dynamos"—that is, commutatorless direct-current dynamos—do not appear in the classification. This is a valid criticism, but we doubt if there are as many as six such machines in commercial operation in the whole of the North American continent. Another omission pointed out is in the direction of asynchronous alternating-current machines with commutators. These also are conspicuous by their absence among us.

A criticism that seems, from our side of the Atlantic, to have more weight, is the question whether the frictional losses in a machine should or should not be considered constant and independent of the load. The standardization report assumes these frictions constant, but M. Guilbert thinks they should be considered as increasing with the load. In the case of direct-driven generators and direct-driven motors, the friction is usually the same at all normal loads unless there is some defect in the apparatus or in its design. In the case of belt-driven and belt-driving machines, the tension on the belt is a variable quantity, and this is apt to introduce increasing frictional losses as the load is increased and the belt tightened. It would be possible, of course, to assume from experimental data, covering a number of different types of belt-driven machines, some factor of increase in friction with the increase of load. This is a refinement that might be worth considering at some future time. On the other hand, it might be pointed out that it is impossible to say beforehand what the belt tensions will be that a machine will have to undergo in actual use, and that in the absence of such information it is best not to attempt excessive refinement in the calculations. In any case, provided it is generally agreed that the friction should be considered invariable, not only will the process of testing be simplified, but it would also be unavailing for one manufacturer to attempt unfair use of the inaccuracy by trying to increase or diminish bearing friction under loads, to the special advantage of his own machine.

The next criticism relates to the friction and windage of direct-driven machines. This is a well-known source of differences in opinion. Strictly speaking, of course, the extra bearing friction which is due to the weight of the generator armature and the extra friction due to the windage of the same, are not accurately attributable to the steam engine or prime mover; and it is also true that in many cases it is possible to mount such a generator in temporary bearings at the factory and drive it by a suitable motor in order to determine these frictions. At the same time, it has been often pointed out that such a test can usually only be made in the factory, if at all, and that the establishment of a rule which required the measurement of direct-driven generator bearing frictions might lead to differences and dissensions in those particular cases where a machine had to be tested on the purchaser's premises. It is also true that the temporary bearings in which such a generator may have to be mounted for the occasion of the test may offer an appreciably different amount of friction from those which are specially built for the reception of the shaft, and consequently that the measurements even when made may be fallacious. This seems to be a matter for arbitrary convention. If the engine builders do not object to assume the friction and windage of the generator on the engine shaft, or, in other words, if the engine losses may be increased by those of the generator frictions for the sake of simplifying the task of the electrical engineer, then there can be no doubt that from a practical standpoint it is better to throw these frictions upon the engine. At all events, it would seem that the only parties who are likely to object are the engine builders and not the electrical engineers.

The next criticism is addressed to the estimation of load losses or those additional electrical and magnetic losses that occur in machines by reason of the reactions occurring under load. It cannot be denied that there is room for criticism in this direction, as the estimation for load losses is admittedly imperfect. It may be possible to improve and amend these estimations in the course of time and added experience.

A salient criticism is made in regard to alternator ratings. It is pointed out that if an alternator has its efficiency guaranteed at a power factor of 100 per cent. or non-inductive load, that this is not pertinent to the behavior of the machine under practical conditions, seeing that non-inductive load is rarely if ever actually attained, and that consequently a rating which is based upon non-inductive load is a theoretical rather than a practical rating. While there may be force in this argument from the standpoint of the purchaser of the machine, yet the opposite position would be manifestly unfair to the manufacturer. It is clearly unreasonable to expect a manufacturer to supply as an alternator of say 100-kw one which will give 200 kilo-volt amperes or double the rated current strength, merely because the power factor of the particular load to which it is applied is as low as 50 per cent. The machine which will carry this inductive load is in reality a 200-kw machine worked on a circuit where its full power cannot be availed of, and a manufacturer will naturally object to sell a 200-kw machine of a 100-kw rating. It seems to us that the correct position is to rate machines at their capacity on non-inductive load, as suggested in the Standardization Rules, but also to specify for certain required efficiencies at stated additional power factors. Then an alternator which has an efficiency of 90 per cent. at non-inductive load might be required by specifications to have an efficiency of, say, 86 per cent. on a power factor of 80 per cent. This would bring the recommendations of the report in conformity with those of M. Guilbert in all substantial respects.

One important remaining criticism relates to the formula for deriving the temperature elevation of a machine from its increase in conductor resistance. Strictly speaking, from the observed resistance at normal temperature, the resistance referred to O°C. should be computed and then, after being heated, the temperature of the machine should be found as the increase above O°C. and hence the elevation above the original temperature. The formula given in the Standardization Rules avoids the double calculation, by adopting the slightly incorrect assumption, to which attention is duty called, that the temperature coefficient of increase in resistivity is the same for all initial temperatures within the range of testing. The error here involved is intended to compensate in part for the effect of changes in the normal temperature upon the heating of the machine, because the hotter the engine room, the higher the dynamo will be heated therein under a given load.

We think that while some of M. Guilbert's views may be opposed to those of electrical engineers on this side of the Atlantic, yet he has done good service in pointing out the improvements which can be made in the Institute Rules from his point of view.

Independent Telephonists Control the Erie System.

Some months ago the possibility that the independent telephone concern known as the Telephone, Telegraph & Cable Company might secure control of the Erie Telephone system was pointed out editorially in these columns. When interrogated by us personally on the subject, President C. J. Glidden, of the Erie, remarked that he was even more independent of the independents than he was of the American Bell Telephone Company; and he continued to pursue his wonderfully aggressive campaign against the "opposition" companies that had invaded the Erie territory. The expected has happened, however, and it can now be announced that the negotiations have been closed whereby the control of the Erie telephone system, the largest Bell system in the United States, passes into the hands of the Telephone, Telegraph & Cable Company of America. The Erie Company controls five networks operating in North and South Dakota, Minnesota, Wisconsin, Michigan, Arkansas, Texas and Cuyahoga County, Ohio, including the city of Cleveland. It employs $22,000,000 working capital, including bonds and notes, as well as its actually outstanding capital stock. The combined interests of the Erie Company on Feb. 15 had 155,000 telephone stations in 2300 cities and towns and 250,000 miles of wire, of which 80,000 is long-distance wire.

The negotiations for the purchase of the controlling interest have been conducted by President Latta and Charles E. Adams, of the cable company, and President Glidden, of the Erie system. The following gentlemen have been added to the Board of Directors of the Erie, representing the new owners of a controlling interest in the property: Charles E. Adams, Lowell, Mass., who has been elected vice-president; John Jacob Astor, New York; George Crocker, San Francisco; Frank A. Cutting, Boston; Frederick A. Farrar, Boston; H. E. Gawtry, New York; W. H. Gelshenen, New York; William J. Latta, Philadelphia; Martin Maloney, New York; C. W. Morse, New York; Daniel O'Day, New York; Frank Tilford, New York, and H. R. Wilson, New York.

The deal involves the purchase outright, for cash, of a very large majority of the outstanding capital stock of the Erie Telephone & Telegraph Company (the total amount outstanding is $10,000,000) by the Telephone, Telegraph & Cable Company of America. The latter corporation was organized, with a capital stock of $30,000,000, to form a rival telephone system to the Bell—one that should extend throughout the country and absorb all the independent telephone companies. The Erie Company is a Bell licensee company, and as such has the legal right to continue to use the Bell patents in all the territory in which it operates. It is one of the few Bell licensee companies, however, the control of which is not held by stock ownership in Bell hands.

The Erie schedule of assets and liabilities on Dec. 31, 1899, was:

ASSETS.

Stocks and bonds owned	$18,310,000
Treasury stock	10,000,000
Accounts receivable	244,193
Undivided earnings	609,080
Cash on hand	301,452
Total	$29,464,725

LIABILITIES.

Capital stock	$15,000,000
Bonds and notes	12,739,403
Reserve	254,144
Surplus	1,471,177
Total	$29,464,725

This schedule has lately been changed by the issuance of $5,000,000 more stock, reducing the item treasury stock by that amount. There is, therefore, $5,000,000 more stock which it is possible to issue, $10,000,000 of the authorized $15,000,000 being now outstanding. The stock has been quoted in the Boston market as high as 123 asked and 116 bid, but it is not known what the Telephone, Telegraph & Cable Company had to pay for the amount they bought. The old Erie concern proper, excluding the other corporations it bought, made net earnings of 9.91 per cent. on its original capital stock in 1899. In the ELECTRICAL WORLD AND ENGINEER of Jan. 27 last a full page map was printed of the United States showing the Erie telephone territories as operated by itself and the subsidiary Cleveland Telephone Company, Northwestern Telephone Exchange Company, Southwestern Telegraph & Telephone Company and the Michigan Telephone Company, including a variety of independent interests already absorbed.

Arguments for American-Made Cable in the Pacific.

The United States Senate has just published and issued as an official document an argument made by Mr. Herbert Satterlee in behalf of the claims and abilities of American manufacturers to make the new Pacific cable and urging the retention of the "American manufacture" clause in any bill passed for such a cable. Mr. Satterlee says that the provision in most of the bills before Congress that the first span of the cable shall be built and laid between the California coast and the Hawaiian Islands within fifteen months from the giving of the order will not deter many American manufacturers from bidding. Orders from the Government for submarine cable have already been filled by the following American companies: The Safety Insulated Wire & Cable Company, of New York; the Standard Underground Cable Company, of Pittsburg; the American Steel & Wire Company, the Bishop Gutta-Percha Company, the Okonite Company, the Kerite Company, the India Rubber & Gutta-Percha Insulating Co., the Eastern Electric Cable Company, Messrs. John A. Roebling & Sons, the Simplex Electric Company and the General Electric Company. Several of these have very large plants, with an enormous capital invested. Some of them have sites on tide water, with a depth of water at their bulkheads sufficient to permit cable-laying vessels to lie alongside of their factories. The probability is that if the provision for American manufacture is retained in the act of Congress providing for the cable, foreign makers will be forced to come over here and organize companies under our laws, and, if they are successful bidders, make the cable on American soil, of American materials, and with American labor.

Mr. Satterlee also calls attention to the specific work done by these various concerns for the different services of the Government, with cable that has been under water for more than five years. He estimates $8,000,000 for making the cable here and $4,000,000 for laying it. It is understood that Mr. Satterlee was primarily retained by the Safety Insulated Wire & Cable Company.

Mr. J. W. Marsh, vice-president and general manager of the Standard Underground Cable Company, also made an appearance and statement before the Senate Committee of Interstate and Foreign Commerce, in which he urged the ability and responsibility of that concern. He called attention to their new factory at Perth Amboy designed especially for submarine cable work, and to the skill that had been shown already in their productions at Pittsburg for the last seventeen years. He added: "Furthermore, if it could be fairly supposed that the American manufacturers do not possess all the requisite knowledge or skill either to make or to lay the Pacific cable, we need hardly point out that 'knowledge and skill' are at the service of the manufacturer who can and will pay the most for them. American manufacturers already excel foreign in many classes of goods, and if the proper opportunity be given, ocean cables will very quickly be added to the list. We have also examined carefully into the statement that all the visible and anticipated supply of gutta percha for a long time ahead has been cornered, and while it is true that the demand has been large, and the price of crude gutta percha has materially advanced in the last twelve months, we are satisfied that we shall be able to procure all of that or any other insulating material that may be necessary for the Pacific cable. We would undertake to furnish the section of cable from San Francisco to the Hawaiian Islands, if necessary, in approximately fifteen months, and the entire cable to the Philippine Islands in two years, after the closing of the contract."

Mr. Marsh also took up the question of laying the cable and pointed out that the Government had already a number of fine transports admirably adapted to cable work. As to the total cost of cable and laying, Mr. Marsh's expert judgment also was that the price could be kept within $12,000,000. He intimated the propriety of favoring home production of the cable, and said: "Should you exclude American manufacturers from the bidding, as will practically be the case without the suggested provision, there is much more reason to fear that the comparatively few European cable manufacturers who are reputed to be already crowded with such orders, will take advantage of the situation to exact high prices, thereby defeating the purpose of procuring the cables at a lower price, and at the same time losing the opportunity of establishing ocean cable manufacture on a large scale in the United States."

Water Power for Electric Traction, Isle of Man Railways.

THE Douglas & Laxey Electric Railway, Isle of Man, was opened on July 28, 1894, and a year later the system* was extended by the addition of a mountain line to the summit of Mount Snaefell, the former being 7 miles and the latter 4¾ miles long. At the time these lines attracted considerable attention in electric railway circles owing to the employment of storage battery substations, being the first instance of the use of fixed batteries in electric railway work. The batteries were installed both for regulation and for reinforcing the power station at times of abnormal load, and they proved successful from the beginning. During the intervening years the system has been considerably extended.

Recently a water-power plant was installed for furnishing current to two of the lines, and the successful results obtained have enabled

FIG. 1.—TAIL RACE.

the steam plants to be shut down entirely, 18 miles of road being worked solely by water power. The road mentioned is used in the summer time for tourist traffic, the load on the several power stations then reaching about 2200-hp, but for about seven months each year the road is dependent on the local passenger and freight traffic, which is comparatively light. As all the coal used has to be imported from South Wales, the financial saving will be very considerable.

The Laxey River, which is seven miles from the Douglas and eleven miles from the Ramsey terminal of the line, has been utilized for obtaining the requisite power. The water has been taken after it leaves the "washing floors" of the great Laxey lead mines, and the tail water is discharged direct into Laxey harbor, the total fall being 41 feet, which, after deducting pipe losses, etc., allows a working fall of 38 feet. As part of the water is used for ore washing purposes at the Snaefell and great Laxey mines, it contains great quantities of sand, and special precautions have been taken to prevent this from reaching the turbines.

The head work consists of a concrete weir 40 feet long by 4 feet 6 inches high, built across the river. At one end of the weir are two masonry archways 5 feet wide by 5 feet high, each fitted with a sluice gate and the necessary gear for raising and lowering the gates. The two gates are separated from the river by means of an iron grating 55 feet long by 5 feet 6 inches high. During floods a large amount of débris is washed down the river, and the gratings prevent the gates from being blocked. Inside the gratings is a large settling tank for the sand, the tank being emptied by opening the gate nearest the weir, which is used as a by-pass for flushing purposes. The other gate is at the commencement of the head race, which consists of 826 feet of trench 5 feet wide, followed by 474 feet of trench 3 feet 6 inches wide, the depth of each being 4 feet 6 inches. The first of these two sections was made larger in area, to allow the water to travel slowly and settle any sand which might have passed through the first settling tank. At the end of the larger section of race another settling tank

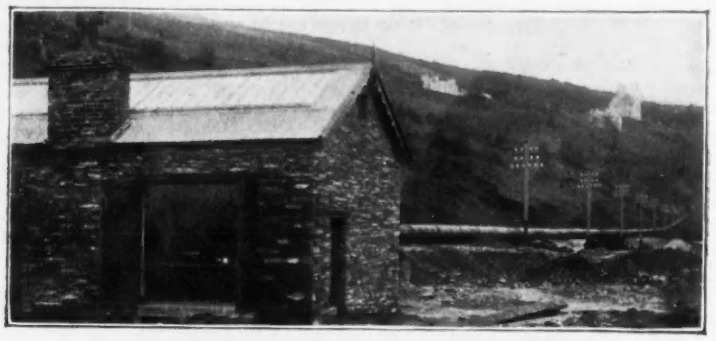


FIG. 2.—WATER-POWER STATION AND PIPE LINE.

has been formed by dropping the bottom of the trench 6 inches for a distance of 50 feet, and providing it with a 12-inch flushing valve. At the end of the second section of race is built a masonry head box 8 feet by 11 feet by 7 feet 9 inches deep, from which the water is conveyed to the turbines by means of 820 feet of steel pipes 3 feet in diameter. The head box has also been built to act as a settling tank, thus preventing any sand from entering the pipes. An overflow weir 20 feet long has been built about half-way along the race, the surplus water being conducted to the river through an underground conduit.

Owing to the bad nature of the ground, the whole of the head race

*Described in ELECTRICAL WORLD, Oct. 24, 1896.

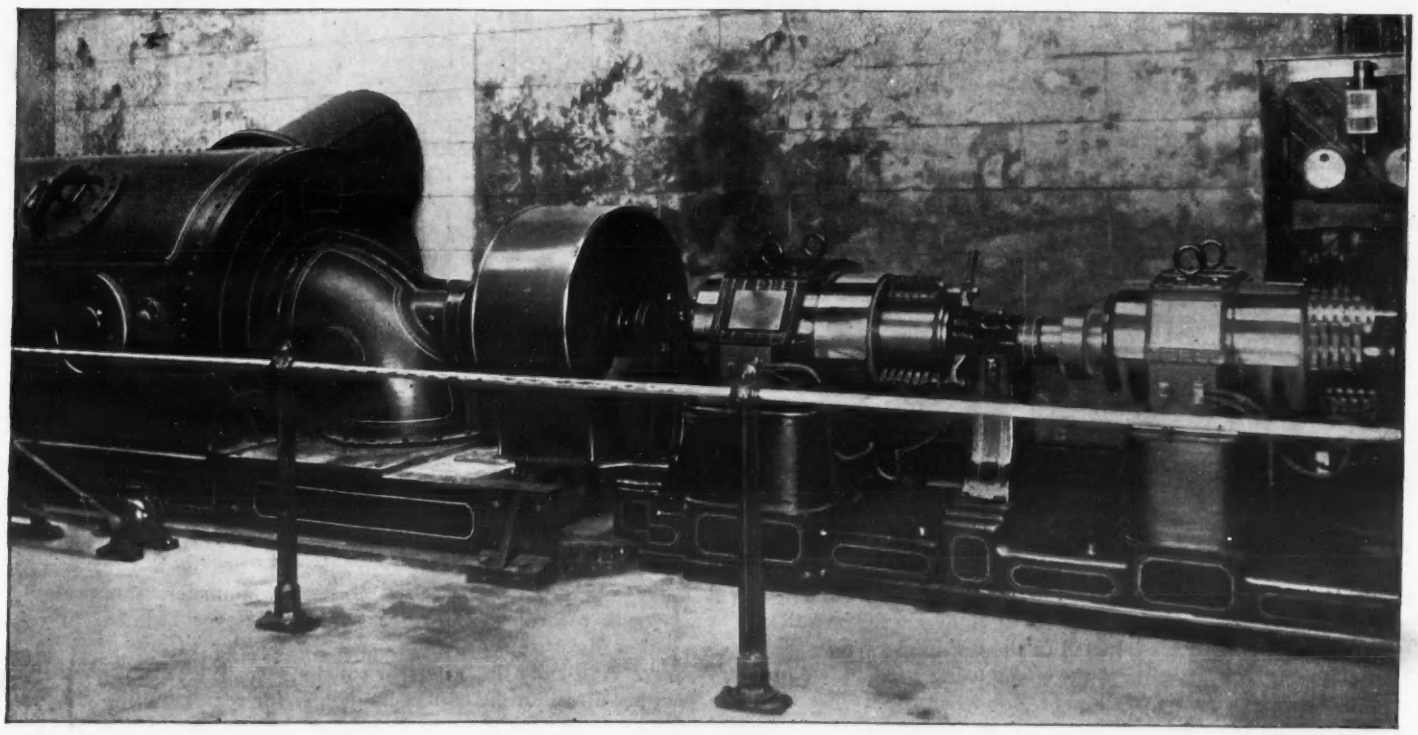


FIG. 3.—INTERIOR OF GENERATING STATION.

has been constructed of concrete, with the exception of one short length built of masonry. The pipe line, which had to be kept several feet above the ground, is supported on masonry piers. The pipes are made up of ⅛-inch steel plates with double-riveted seams, and are fixed in 15 feet lengths. The joints are made with Kimberley collars run in with lead and well caulked.

The tail race is 624 feet in length, 10 feet wide and 13 feet 3 inches below the floor of the turbine house, and terminates in Laxey harbor.

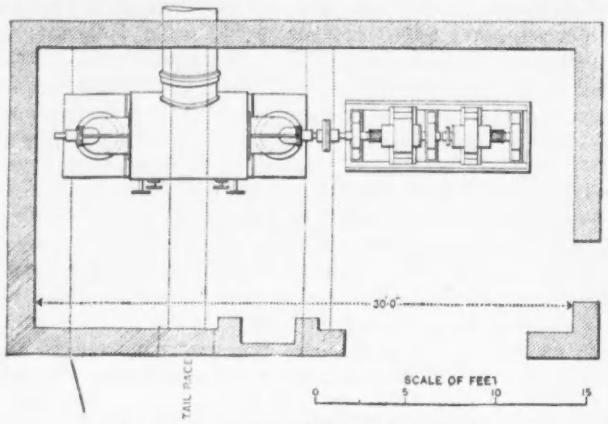


FIG. 4.—PLAN OF GENERATING STATION.

The turbine house is 1100 feet away from one of the company's steam power stations, and is a stone building 30 feet long by 15 feet wide by 12 feet high. The fall from the level of the weir to the centre of the turbines is 26 feet, the remaining 15 feet fall being obtained by means of draft tubes. The turbines are of the "Victor" horizontal type, and consist of two independent 12-inch turbines in one casing with the shafts direct coupled; so that, when there is only a small amount of water available, one turbine will be used, thus enabling the plant to be worked at its best efficiency. The turbines will develop 140-hp at a speed of 720 r. p. m.

The electric generating plant consists of a combined bipolar dynamo and booster, the generator having an output of 160 amperes at 520 volts and the booster 160 amperes at from 200 to 300 volts. The generator and booster are coupled to the turbine by means of a friction clutch, which permits of the plant being used as an ordinary motor-driven booster in the summer time when the river is very low. The turbines, generator and booster are provided with self-lubricating bearings, and are capable of maintaining long continuous runs without heating.

The mains from the generator and booster and the regulating wires are carried overhead to the steam power station previously re-

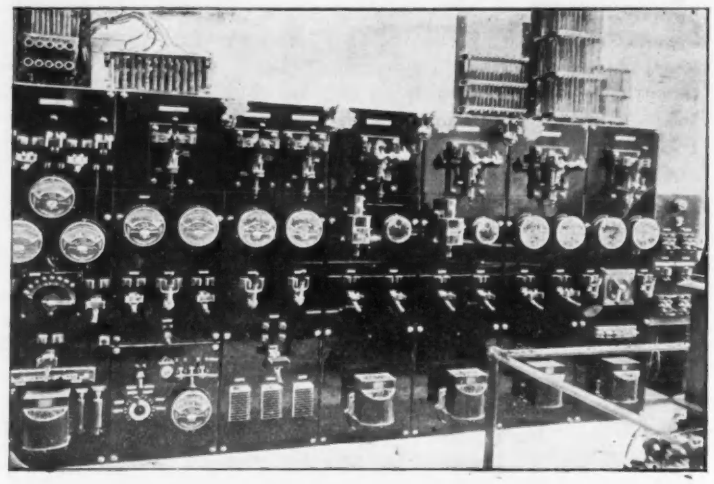


FIG. 5.—SWITCHBOARD AT GENERATING STATION.

ferred to, from which the turbine plant is entirely controlled. Two Lundell ¼-hp motors, driven from a small storage battery, are used for opening and closing the turbine regulators. The switch panels for the generator and booster are attached to the main switchboard in the steam station. They comprise one generator panel, together with automatic switch, ammeter, voltmeter, positive and negative switches, shunt regulating switch, starting switch and resistance to work the generator as a motor for driving the booster when the water is low, and a recording wattmeter. The booster panel contains switches for controlling a motor-driven booster in the steam station, and also the switches for controlling the turbine booster—viz., positive and negative switches, voltmeter, ammeter, shunt regulating switch, recording wattmeter and change-over switches to connect either the turbine booster or motor booster to any of three feeders. Adjoining the generator panel is a small panel for controlling in either direction the two ¼-hp motors for regulating the turbines. A

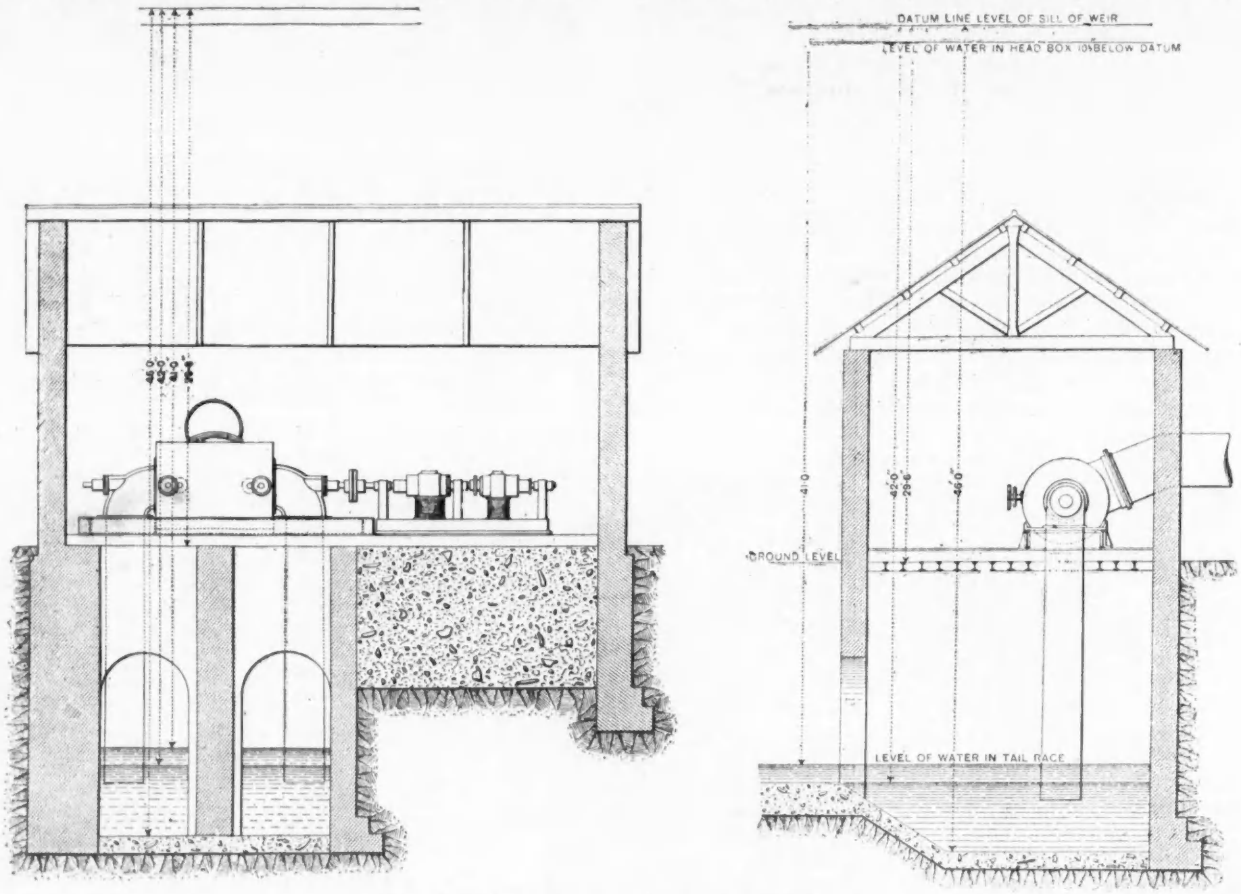


FIG. 6.—ELEVATIONS OF GENERATING STATION.

small pipe has been carried from the head race, and is attached to a gauge glass fixed in a prominent position near the switchboard, so that the attendant can see the height of the water in the head race.

The turbine plant is worked in connection with three battery substations, each containing 250 cells of the Chloride type, one at Laxey, at the foot of the Snaefell mountain railway, and the other two about five miles on each side, all three stations being worked in parallel. When the cars are taking current the turbine generator is assisting the batteries, but when the cars are descending the grades or standing the generator is charging the batteries. During the night time when the cars are not running, the booster is connected in series with the generator, and the batteries are in turn charged at a heavy rate and at a high voltage through the underground feeders. This enables a full load to be maintained continuously on the turbines.

The turbine plant described above recently completed a 240 hours continuous test, during which it maintained a steady load varying from three-fourths to full load; and although the turbines are not provided with any governor, it was not once necessary to alter the regulation.

The construction of the weir, water courses and buildings, and the erection of the plant were carried out by the company's staff under the superintendence of Mr. J. Shaw, general manager and engineer, to whom the London *Electrician,* from the columns of which journal we extract this description, was indebted for the illustrations and particulars of this interesting example of water power and storage battery utilization for electric supply.

An English Steam Turbine Electric Generating Plant.

The directors of the Cambridge (England) Electric Supply Company a short time ago decided to install a new alternator of considerably larger power than its present machines, and invited tenders from five leading English firms for a 500-kw direct-connected steam unit. The prices quoted by four of the five firms competing were as follows: A, $20,500; B, $27,280; C, $24,400; D, $24,400, none including condenser and pumps. The fifth firm was E. Parsons & Co., whose bid was $24,120, including condenser and pumps.

date any single set offered by the other four contractors, while it is possible to install two such as the accepted design; in fact, a duplicate order has been placed for a second set at the same figure, for delivery this year. In addition to other advantages of a turbine-driven plant the guaranteed consumption of steam per kw-hour for this size was lower than that of the other makers. The figures are given below:

	25% overload. Pounds.	Full-load. Pounds.	Half-load. Pounds.
A	..	28	34
B	..	28	34
C	25.5	27	32
D	..	26.6	31.2
E. Parsons & Co.	..	27	30

The last figures included the amount of power absorbed by the air and circulating pumps, and is without any margin. The other four claim a margin of 5 per cent., equal to at least an increased consumption of 1.25 lbs. of steam.

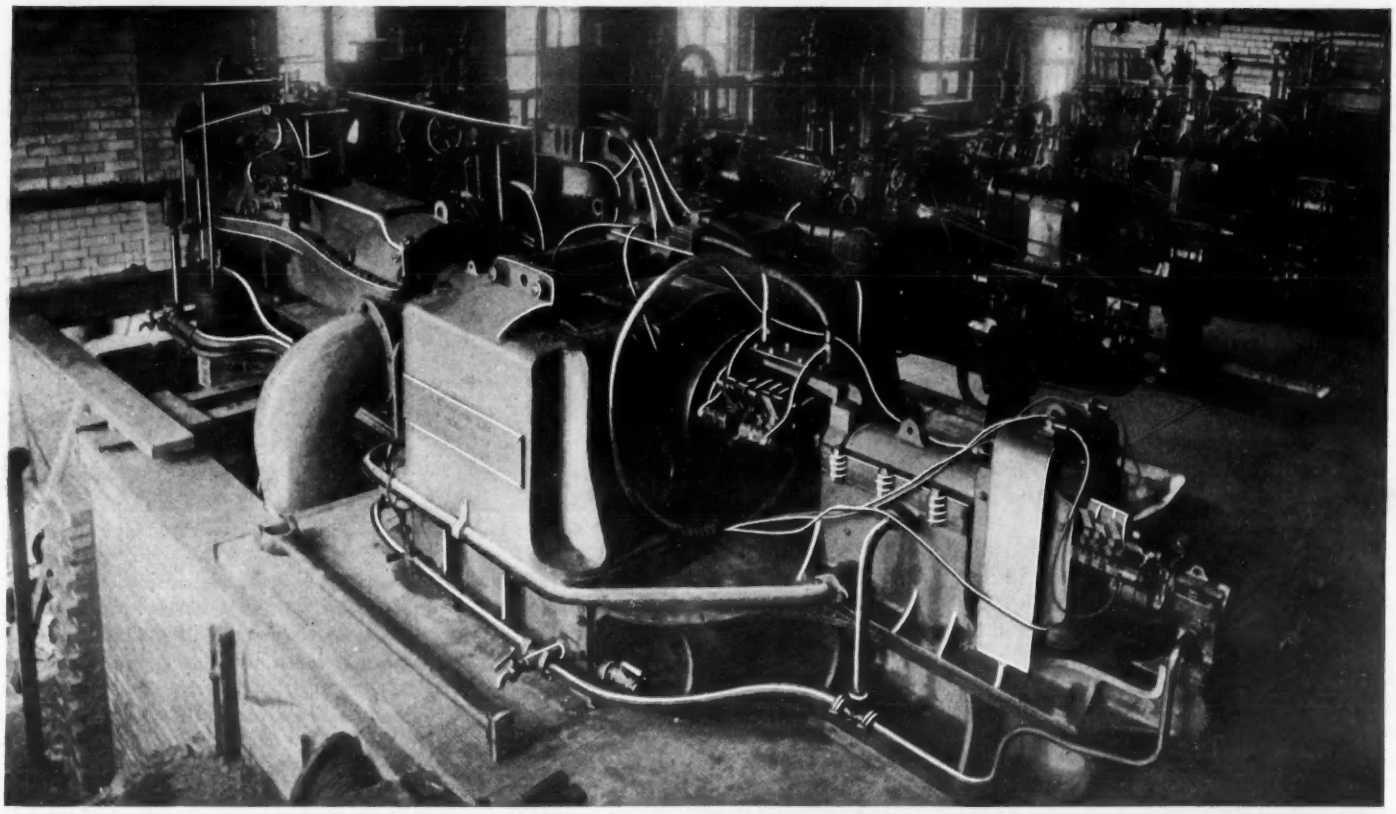
The plant was tested at the makers' works, Newcastle-on-Tyne, in October last by the company's engineer, Mr. J. H. Barker. It was impossible to attach the condenser belonging to the engine, as this was already fixed and built in place at the Cambridge works. The figures are therefore comparable for all makers, as an independent set of pumps separately driven was used.

The tests lasted over four hours and gave the following results:

Boiler pressure	127	139	145	140
Vacuum	24¾	24½	26¼	27½
Water per hour, lbs.	13400	12675	7029	4180
Output in kilowatts.	598	526.4	256.1	124
Water per kw-hour.	22.4	24.1	27.5	33.7
Excit'g cur'nt per kw.	3.5	3.3	3.1	3.0

When in position with its own condenser it is hoped to get even better results as a higher vacuum will be maintained than is possible with a condenser at the distance necessary in this case and the numerous branches on a test house exhaust main.

The purchasers consider that the figure of 22.4 lbs. of steam (at 127 lbs. pressure) per kw-hour for a high-speed engine of this size



CAMBRIDGE, ENGLAND, STEAM TURBINE ELECTRIC GENERATING PLANT.

In accepting the tender of the latter, the directors were guided by the following considerations: The cost of a condenser and pumps with independent engine was about $5125, which fact reduced the Parsons' tender to $18,995. A more serious consideration was that the space in the present engine room was not sufficient to accommo-

is extremely satisfactory and not previously obtained, and that a consumption down to one-quarter load of only 33.7 lbs. is a remarkably good performance.

The photograph shows the set erected in position at Cambridge. The engine is Messrs. Parsons & Co.'s patent parallel-flow turbine,

and runs at a speed of 2700 r. p. m. It exhausts through a pipe at each side to a surface condenser in a tunnel below. At the high-pressure end of the engine the shaft is extended and drives a worm which is geared to a wheel and drives a crank on either side, which in turn operates the air and circulating pump below. This method of pump driving has proved very satisfactory in practice. The first worm wheel put in for this purpose has been at work for four years and is in good condition still, running daily.

The alternator is coupled direct to the turbine, and is of the four pole type with rotating armature delivering current at 2000 volts at 90 periods per second. To the same shaft is coupled the exciter dynamo having a capacity of 5-kw, though only 3.5 are required for excitation of the alternator, equivalent at full load to 0.7 per cent. of the output.

It was impossible to deliver the engine in time for the winter of 1899, and the plant at the disposal of the company was not powerful enough to run through without heavily overloading. Messrs. Parsons & Co. therefore offered to loan a 100-kw set, non-condensing, which was erected in the basement of the engine room, resting on four blocks of timber laid direct on the soil. Three rigid connections only were required, a 3-inch steam pipe, a 10-inch exhaust pipe, and a cable to the switchboard. The total cost of erection was under $25. It is safe to say that no other class of plant can be so readily adapted in urgent cases, nor could an ordinary engine of the size possibly be run under such simple conditions of foundations. As a matter of fact, the engine ran more silently than any of the fixed machines and was quite as good in all other respects.

Finsen's Phototherapy.

BY S. D. BENOLIEL.

MUCH success has recently been obtained in the application of the arc light to the cure of a number of local superficial bacterial skin diseases, which until recently have baffled the skill and remedies of physicians. The method consists in utilizing the chemical rays emitted by the arc lamp.

It has been experimentally proven that the chemical rays of light—that is, the violet, ultra violet and blue—have the power to kill bacteria. This was originally demonstrated by Downes and Blunt, and later by Finsen, of Copenhagen, and a number of other investigators. On the other hand, the yellow, green and red rays exert little or no bactericidal effect, and are, therefore, useless. If it is desired to employ this germicidal property of light therapeutically it is obvious that the greatest possible number of violet and ultra-violet rays must be procured. It has also been found by Godneff and Finsen, who performed a large number of experiments on the subject, that these chemical rays have the ability to penetrate the skin.

The sunlight contains many violet and ultra-violet rays, yet the strongest light in summer is only sufficient to kill thin plate cultures in a couple of hours, and is not strong enough to penetrate the skin for the cure of bacterial skin diseases. If this bactericidal property of light is to be used advantageously, it is necessary that the bacteria should be quickly killed. In order to accomplish this, Dr. Finsen found that the light must be very intense and concentrated. To obtain this energetic effect he concentrated the sunlight with the aid of large lenses, or, what is better, since it is always procurable, he used strong arc lights which abound in these germicidal rays and which at the same time are very intense.

Dr. George G. Hopkins, of Brooklyn, was possibly the first to introduce this method of treatment in the United States. He follows very closely the method devised by Dr. Finsen. Fig. 2 shows the arc lamp he uses, which was specially built for this purpose, and requires 80 amperes, being rated at 22,000-cp. On starting, the voltage across the arc and regulator is 50, but as the light becomes steady it drops to 37, remaining very nearly constant at this pressure. The current is supplied from the street 110-volt circuit, the voltage being cut down by a dead resistance in series, which is, of course, a very uneconomical method. The writer has suggested the use of a motor-dynamo which could transform from 110 volts and 35 amperes to 40 volts and 80 amperes, effecting a saving of nearly 60 per cent. on the present amount of electrical energy consumed.

The lamp is so mounted as to be quickly shifted into any desired position and held absolutely free of any vibration. An iron disc to which three iron bars are attached is secured by the upper ends of the bars to the ceiling, while their lower ones hold a circular band of iron. To this disc an iron tube is secured into which a bar passes, whose other end has a Y to which the lamp is attached. This arrangement, together with a clamp screw, allows of a vertical and a rotary motion. An open quarter-circle attached to the head of the lamp, and a clamp attached to the Y, allow a tilting motion to be given. With these adjustments the lamp can be placed in any desired position, which is necessary in order to focus the light through a long telescopic tube which will be shortly described. These adjustments are Dr. Hopkins' improvements over Finsen's mounting.

A metal band hides the light from the patient, when the lamp is placed in proper relation to the focusing tube At the lower portion of the band an arm is secured, so arranged that when a collar on the focusing tube is attached to it, the axis makes an angle of 45° with the line of direction of the carbons. This is very important, since in an arc lamp this is the position in which the tube will intercept the most concentrated rays, being the direction of maximum illumination of the arc. A pan is attached to catch any sparks which may drop from the carbons. The lower carbon is solid, seven-eighths of an inch in diameter; the upper carbon is cored and one inch in diameter. It has been found that carbons with even a very minute core will not work well for the lower carbon, since it makes the light unsteady.

Behind the carbons is a small reflector which tends to throw the light in the direction of the tube. This can certainly be improved upon, since only a small portion of the reflected light impinges against this tube. The writer has suggested the use of a reflector which would cover a much larger portion of the arc and of such a shape that nearly all the reflected rays would be concentrated in a very small area. In this way we could obtain the same intensity of light with a much smaller lamp.

The optical portions of the apparatus consist of a telescopic tube and a piece of apparatus designed to receive the rays and transmit them to the diseased portion of the skin. The former consists of two tubes capable of sliding into each other; the one nearer the light is 25" long and 2½" in diameter, and the other 24" long and 1¾" in diameter. The idea of this arrangement is to allow the operator to bring the tube as near the patient as may be desired. At the end of the tube which faces the light are two plano-convex

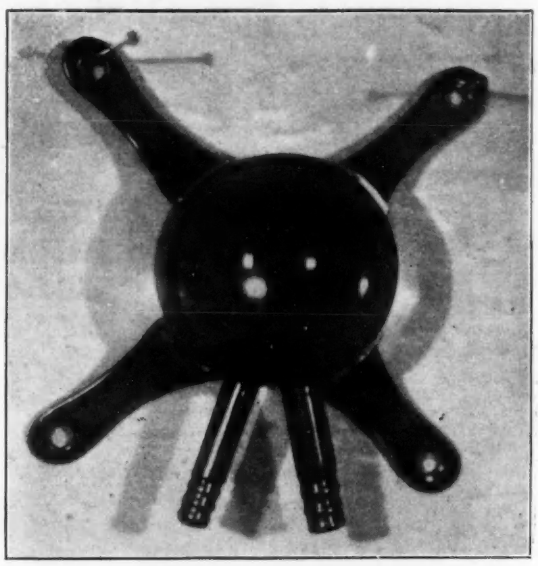


FIG. 1.

lenses of quartz 2½" in diameter, with the plane sides touching, giving together a focal length of about 4¾". Quartz is used instead of glass, because it allows the short violet and ultra-violet rays of the arc lamp to pass through it more readily than glass. When these lenses are placed at a distance from the carbons equal to their focal length, they will concentrate all the divergent rays and bring them into parallelism with the axis of the tube.

At the end of the lower tube is a chamber 6½" long by 1¾" in diameter. At the upper portion of this chamber is a quartz disc and at the lower end a quartz lens 1½" in diameter. This chamber is filled with distilled water, its function being to cool down the rays that pass through it. It has been found that after a very short time this water becomes very hot. To prevent this, the chamber is surrounded by a water jacket, through which cold water is continually kept flowing.

The quartz lens has a focal length of 4", so that all the germicidal rays are concentrated with great density 4" from the distal end of the tube. At this distance is placed a piece of apparatus de-

signed to catch these rays and transmit them to the diseased portion of the skin. It consists of a brass ring into which is set a convex lens and a plate of quartz with a water space between them through which water is kept flowing continually. By the time the rays pass through this water chamber they are perfectly cool and consequently do not exert any burning effect upon the skin. This arrangement, which is called the skin lens, is attached to the patient by means of elastic tapes.

This method of treating certain skin diseases has been very successful. Dr. Finsen has had under his supervision over 350 cases of lupus, all of which were treated by this method with the most satisfactory results. It must be remembered, however, that the cure is necessarily slow, as only one portion of the skin can be exposed to these rays at a time, and that this has to be repeated very often. Dr. Hopkins' apparatus has been installed only three months, so that he has had only a few cases, but all of these, without exception, have been cured or have shown steady improvement.

FIG. 2.—ARC LAMP.

It is certainly a source of great satisfaction to electricians to witness another new application of electricity, and to feel that when a source of light is required to approach closely both in intensity and quality to the sun, that the medical profession is compelled to adopt the arc light as the best substitute. In the way that physicians have brought into use static machines, Rhumkorff coils, galvanic currents, Röntgen rays, and finally the arc lamp, let us hope that other electrical appliances will find their way into their hands for the alleviation and cure of suffering humanity.

The writer begs to acknowledge his thanks to Dr. Hopkins for the many kindnesses shown him in the preparation of this article, and it is but fair to add that this interesting lamp was manufactured by Mr. Charles J. Bogue, the well-known arc lamp manufacturer of New York city.

Wireless Telegraphy in War.

In a lecture before the Royal Institution, London, recently, Marconi referred in an interesting manner to the work done by one of his assistants in South Africa. He said that stations had been established at the Modder river, Belmont, Orange river and De Aar, and that they had worked well. Other attempts were to be made in Natal, with General Buller. The Boers had no instruments, except a few that had been made in Germany, and would not work.

The Nernst Lamp.

BY W. MCA. JOHNSON.

THE Nernst lamp has now been so perfected that the engineers of the German company are going to subject it to the test of commercial usage. When Prince Albert of Prussia came to celebrate the opening of the "Twentieth Century" at the University of Göttingen his apartments were lighted with Nernst lamps. Now the lamp is being advertised in Göttingen for house and store lighting. The lamps are rented for 12 cents (50 pfennigs) a month and will remain the property of the company. The lamps are to be used on the regular commercial 110-volt circuit and require about 0.3 ampere for 25-cp. The company supplies an alcohol heater and expressly forbids the use of matches.

Of course, the great desideratum is a quick-acting, reliable automatic heater which can be produced at a reasonable cost. The number of attempts to reach this result can be seen by a glance at the number of German patents for "self-kindlers" which have been taken out not only by the engineers of the German company, but by others.

Several attempts were made with mirrors of various geometrical shapes with a heating coil in one focus and the magnesium staff in the other. The practical difficulties have not been overcome, however. The automatic lamps of the present have the heater placed in

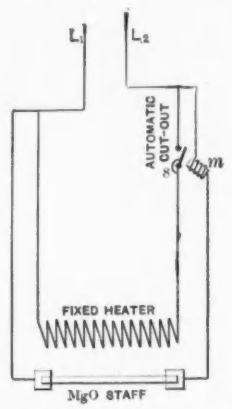


FIG. 1.—FIXED HEATER FOR SMALL NERNST LAMP.

close proximity to the staff. Of course, such a model could only be used for low candle-powers. Fig. 1 is a diagram of such a lamp.

Fig. 2 is a diagram of a new automatic lamp which is designed for higher candle-powers. The current from the lead L, goes to heating resistance R, of a platinum alloy wire wound back and forth on the hollow cylinder B, which is made of some hard infusible material. The walls of B are very thin, and there is a long narrow opening at the under side, running parallel to the axis of the cylinder. Before the switch is thrown, B stands in a position enclosing the staff A of infusible oxide, which has a very high resistance, in the millions of ohms when cold. The heating effect of the current through R, warms A, and its resistance falls so low that enough current goes through A to make it heat itself, that is, until the C^2R effect in A is greater than the radiation. A is thus brought to incandescence and enough current goes through the electromagnet m, in series with A to cause it to pull up the heater B 4 or 5 inches above the staff. At the same time the automatic switch S is operated by M_2, a second small electromagnet, and R_1 is cut out. In the figure, B is shown midway between first and final positions. B_1 runs in guides and the slit in under side enables it to enclose the magnesia staff.

The efficiency of the lamp is very high compared with the ordinary incandescent lamp—from 1 to 1.75 watts per candle-power—and it is possible that the lower limit may become still lower. This result is attained through the extremely high temperature of the incandescent oxide, which is about 2000°-2500° C. The proportion of visual rays emitted by the oxide is proportional to some high power of the absolute temperature—between the limits above given something like the 5th power.

The same cause which operates to make the Welsbach light so efficient also makes the Nernst lamp efficient. The incandescent oxides exhibit the phenomenon of selective emission and send out light waves which correspond to the periods of vibrations of the molecules. The efficiency of the light can also be increased by making the staff hollow, which increases the illuminating surface per unit of weight, and consequently for rods of same length, per ohm of resistance.

The life of the lamp is about equal to that of the ordinary 8-cp carbon filament incandescent lamp. There will undoubtedly be great improvement in this particular in the future. At present the life of the staff is a less important factor in the Nernst lamp, because a new staff can be replaced in the old lamp at a comparatively small cost.

The staff of the 125-volt 25-cp Nernst lamp is short, and so high-voltage Nernst lamps can be made which will have advantages over the 110-volt lamp. This, of course, will be a factor in the future development of the lamp in light of the modern tendency to high-voltage work.

All previous attempts at making lamps with a platinum filament covered with a highly incandescent body have failed because the platinum melts at a temperature of about 1700° C., and the oxide does not reach the high temperature of the Nernst lamp, and also because the oxide transmits the heat waves that it absorbs from the hot platinum wire, according to Kirchoff's law, as has been pointed out in the ELECTRICAL WORLD.

The Nernst lamp can be used for either direct or alternating current. The magnesium dissociated at the negative pole of the direct-

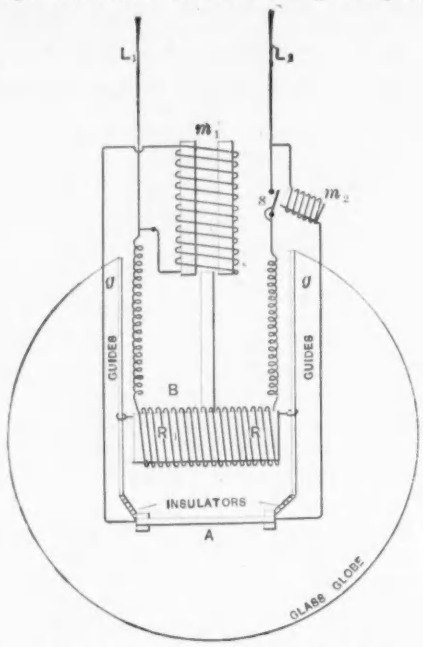


FIG. 2.—AUTOMATIC SELF-LIGHTER.

current is at once oxidized by the air and the oxygen at the positive pole is given off. In time a "heaping up" of the MgO is noticed at the negative pole.

The relation between efficiency and "self-illumination" on one side and composition of the staff on the other, will perhaps add more light to the Van't Hoff theory of solid solutions and conduction in solid bodies by electrolytic dissociation. In all cases of electrolytic conduction the centrifugal force of the atoms due to heat is great enough to overcome chemical attraction of the atoms for each other. In a water solution the electrostatic attraction is not great enough to bring the parts of dissociated molecules together because of the high dielectric capacity of the solvent water. In the case of fused salts, a high temperature, 200°-500°, is required to give disruptive force enough to break up the molecules, which are not simple molecules, but two or more molecules bound together. With MgO, etc., a still higher temperature is necessary because the polymeric modification of solid bodies is greater. It is only when a considerable number of the molecules are broken up and then dissociated into ions that the body becomes a conductor. The development of the theory of solid solutions will perhaps be of equal importance in the scientific world to the advent of the Nernst lamp in the engineering world, and we may look to the distinguished inventor of the lamp for light in this direction.

Prof. Kintner's Appointment.

Prof. S. M. Kintner has been appointed successor to Prof. Reginald A. Fessenden to take charge of the electrical engineering department of the Western Pennsylvania University, Allegheny, Pa. Prof. Fessenden, as noted recently, has joined the technical staff of the United States Weather Bureau at Washington.

Economic Equipment of Electric Stations.

BY ALTON D. ADAMS.

A PREFERENCE for a few large direct-connected generating units is rapidly gaining ground in electric stations. This movement is induced by the saving of space and higher efficiency with such equipment, over a much larger number of small engines and dynamos, and the expectation that a larger part of the energy from the coal consumed may thereby be delivered to consumers. There is of course no doubt about the increased efficiency of large units with compound condensing engines, but how much of this gain at the generators can be made to appear in a comparison of coal bills with consumers' meters or flat charges, must depend to a large extent on the kind of generating units selected and the necessary transformations and conversions of the energy between the main dynamo terminals and the distribution lines. A very large class of American central stations are so situated as to their service areas that substations are not considered desirable for the transformation of current as to the kind or pressure, though substations with batteries may still be used to secure additional capacity at times of maximum load and to regulate the pressure on distribution mains. In this class of stations the electric pressures commonly available for the distribution of direct, alternating, constant pressure and constant current electric energy to consumers' premises are considered sufficient to render the cost of conductors practical. Such generating stations contain all machinery necessary for the transformation and conversion of the current before it reaches the user, except motor-generators for the batteries at substations, which simply raise the feeder pressure for battery charging, and except transformers at supply mains or buildings, as required with most alternating current service.

Three general plans for the equipment of these generating stations are found more or less perfectly worked out in existing plants. It seems evident at the start that those kinds or combinations of apparatus which combine, if possible the lowest total first cost and the highest subsequent efficiency of operation, to produce the several forms of electric energy required by consumers, form the best central station equipment, and an effort is here made to determine the main elements of such combinations for the general case cited.

The most common main generator sets, in stations that supply their entire output without transformation or conversion at substations, are those of uniform direct current, low pressure type, as found in most three-wire stations. These three-wire direct current plants have thus far tried to furnish but little energy beyond the limits of their 250-volt mains, and hence have had but little use for converting and transforming equipment at the main or substations; but where they wish to extend their field of operations, as some are now doing, it is evident that direct current motors, arc dynamos, rotary converters and transformers may be located at the generating plant and operated from the main dynamos. Another, and more recent class of stations, under the first general plan, is that whose main generators are all of the alternating current type, with auxiliary transformers, rotary converters, alternating current motors and arc dynamos, for the production of the several forms of electric energy, adapted to the requirements of their service, located in the main plant.

Stations on the second plan, as considered here, have their main generators divided between the alternating and direct current types, each supplying its appropriate part of the load, and, if desired, furnishing energy in addition either to transformers, motors and arc dynamos or transformers and rotary converters to put a part of the alternating current load onto the direct current main generators or a part of the direct current load onto the main generators for alternating current. This last provision makes the maximum capacity of the main generators available, whatever the character of the demand, and also enables each generator to usually operate at nearly its full capacity.

The third plan for station equipment includes double-current dynamos for main generators, either in whole or in part to such an extent that no auxiliary apparatus is necessary to shift either alternating or direct current load onto generators of the other type. This third plan includes transformers only to raise the pressure of current from the alternating side of double-current generators or to reduce the pressure of energy from some of the alternators for driving motors and arc dynamos, and no rotary converters are necessary. It seems at once evident that, the ideal equipment as to main generators, both for first cost and efficiency of station operation, in-

cludes those which are able to serve any demand from consumers without, or with the least, auxiliary machines, provided the requirements for maximum station capacity, the fully loaded operation of each generator and sufficient flexibility in the application of each generator to the several kinds of service are maintained. It is therefore desirable to determine which of the general plans for main dynamos, as above indicated and in actual use at different stations meets the conditions named with the smallest capacity in auxiliary apparatus.

Taking up stations of the first class, where all of the main generators are of the alternating current type, with pressure sufficiently high for general distribution by transformers at consumers' premises, an excellent example is found in a very large new station put in operation some months since and claimed to include the best engineering features for a plant of its kind. The station in question has for main generators alternators only, which operate at a pressure suitable to supply a large and rather widely distributed transformer load for general business and residence lighting. This station supplies also several thousand direct-current series arc lamps and many hundreds of horse-power in direct-current motors, at about 500 volts pressure. The arc lamps are operated from series arc dynamos of one of the well known types, and these arc dynamos are driven by direct connection to a number of alternating current motors. To supply these motors, current from main generators is reduced in pressure by transformers, so as to avoid the line voltage in motors of moderate size. Energy for the direct current motor circuits at about 500 volts, is derived from rotary converters supplied by transformers that are connected to the main generators.

All of this apparatus is in one station, the auxiliary machines but a few feet from the main generators, and outgoing lines convey 500-volt direct current at constant pressure, 3000-volt direct constant current and alternating current for distribution through transformers at consumers' premises. Between main generator terminals and those of the arc lamps served, the electric energy undergoes three transformations or conversions. Considering full load conditions as to arc lamp circuits and the auxiliary apparatus concerned in their supply, efficiencies of 95, 85 and 80 per cent. may be assumed for the transformers, alternating current motors and arc dynamos respectively.

On these figures the combined efficiency of these transformers, motors and arc dynamos, or the ratio between the energy absorbed by the transformers and that delivered to arc lamp lines is $95 \times .85 \times .80 = 64$ per cent. Allowing a development of one indicated horse-power hour in the cylinders of compound condensing engines on two pounds of coal, and that an engine and generator have a combined efficiency of 85 per cent. as to this indicated power, the energy delivered to arc lamp lines requires a consumption of $2 \div (64 \times .85) = 3.70$ pounds of coal per horse-power hour or $1.33 \times 3.7 = 4.92$ pounds per kilowatt hour. For each kilowatt capacity of arc dynamos, the alternating current motor capacity is $1 \div .80 = 1.25$, the transformer capacity $1.25 \div .85 = 1.47$, and the main generators $1.47 \div .95 = 1.54$; so that the combined capacity of electrical equipment per kilowatt output from arc dynamos is $1 + 1.25 + 1.47 + 1.54 = 5.26$ kilowatts. As noted above, the combined efficiency of the electrical auxiliaries for arc circuits is 64 per cent., and, allowing 92 per cent. for the main generators, the total efficiency between engines and arc lamp lines is $64 \times .92 = 59$ per cent., and the engines therefore have $1 \div .59 = 1.70$ times the output delivered by arc dynamos. When arc dynamos are driven by engines without intermediate equipment, the relative capacity of engines to dynamos is as $1 \div .80$ or 1.25 times as great, so that the electrical drive above considered requires $1.70 \div 1.25 = 1.36$ times as much engine capacity as the case where arc dynamos and engines are direct or belt connected.

Turning now to the equipment for the production of 500-volt direct current for the motor load, including transformers and rotary converters, and allowing an efficiency of 90 per cent. for the rotaries, the combined efficiency of the main generators, transformers and rotaries is $92 \times .95 \times .90 = 78$ per cent. The several capacities for each kilowatt delivered to the 500-volt lines are, rotary converters 1, transformers $1 \div .90 = 1.11$ and main generators $1.11 \div .92 = 1.20$, making a total capacity of $1 + 1.11 + 1.20 = 3.31$ kilowatts in electrical machinery for each kilowatt delivered by rotary converters.

Compared with main generators delivering the direct current at 500 volts to supply lines, with efficiency of 92 per cent., as assumed above, the arrangement with electrical auxiliaries has only $.95 \times 90 = 85$ per cent. of the efficiency, requires a main generator 1.20 times as large and an engine of corresponding increase of capacity. It should be held in mind that for the case now considered there is no advantage as to transmission and supply lines to offset the great increase of cost and decrease of operative efficiency due to the equipment of the main station with the electrical auxiliaries named. Where such auxiliaries handle but a very small per cent. of the total central station output the investment and efficiency involved may be of slight importance, but when such equipments operate to capacities of thousands of horse-power in a single plant it may well be considered whether they represent the best solution for diversity of service from a single station.

Where all of the main generators of an electric plant are of the direct current type, as is often the case, the transformations and conversions necessary to meet the usual diversified requirements of public supply do not involve so large a first cost or so low an efficiency of operation as is the case with main alternating current generators. Direct current at constant pressure for either lighting or power is supplied at once from the main generators, so that for this part of the load the capacity of electrical machinery is $1 \div 3.31 = .32$ of that necessary with alternating generators, and the efficiency of operation is 92 per cent. instead of only 78 per cent. as above. The engine capacity for the direct current plant is also reduced, being four-fifths as great, as to the direct current constant pressure load, as with the main alternating dynamos. Still using electric drive for the arc lamp dynamos, in the direct current station, transformers and alternating current motors are displaced by motors for direct current, thus saving the cost of any losses in transformers, also something between the first cost of direct and alternating current motors. In the conversion and transformation necessary to produce high pressure alternating from low pressure direct current there is a disadvantage equal to that of the reverse process, and the direct current dynamos must be supplemented with rotary converters and transformers for the purpose. Comparing the advantages of direct and alternating current generators for stations that supply both kinds of service and are to have all of their auxiliary machinery in them, the alternating generators may be preferable when as much as three-fourths of the output for the entire plant can be taken from them direct to distribution lines. Where as much as one-half of the station capacity is desired for distribution as direct current, it seems from the above figures that a complete equipment of direct current generators is preferable to a like number of the alternating type, and as the per cent. of total energy distributed as alternating current decreases, the disadvantages which attach to the use of that type of generators exclusively are more marked. The second general type of station equipment, as to main generators, is that in which the entire capacity of generators is divided between those for direct and those for alternating current, in approximately the same ratio as are the output requirements.

Such a station will ordinarily use its alternating current generators for all of its regular alternating service, its direct current generators for all of its direct constant pressure service, and if motors are required to drive arc dynamos, they will be for direct current, while if arc lamps are operated by alternating current or by direct current from rectifiers, the main alternating generators will furnish the required energy through special transformers. In such a station transformers and rotary converters may be used to apply alternating generators to direct current service, or direct current generators to alternating service when such transfer is desirable to keep one or more generators fully loaded, to help carry a maximum load of either character or to apply any generator to a load for which it is not adapted. If the capacities of the direct and alternating current generators are properly proportioned to the station loads, it seems certain that only a very little energy will have to pass through station transformers and rotary converters, unless it is desired to work every generator on any part of the load, of which requirement for regular practice the necessity may be doubted.

It thus seems that the main station with generator capacity divided between direct and alternating currents, to suit the requirements of service, is in a position to deliver most of its energy direct from generators to supply lines and should, therefore, be moderate as to first cost and efficient as to operation of its electrical machinery.

The third station plan to be here considered is that in which a part or all of the direct and alternating current generators formerly considered are replaced by double current generators. Unless it is necessary that each generator operate on any part of the station load, it does not appear that a complete generator equipment of the double current type will be preferable. Considered as to the low pressure direct current supply, the double current generators present no dis-

advantage, save a somewhat increased first cost, but on the high pressure alternating current service transformers must be used for the entire output, which would not be necessary with high pressure alternating generators. In ordinary practice it would offer no advantage to supply alternating current at a low pressure, corresponding to that of the direct, so transformers must in each case be provided with the double current generators. If only a sufficient number or capacity of double current generators are used in a station to insure full loaded operation, when neither an additional direct or alternating current dynamo can be used up to its full capacity, the saving made as to auxiliary equipment is that of rotary converters, since only transformers are necessary to raise the pressure from the alternating side of the double current machines. If, on the other hand, it is required that each generator be capable of application to any part of the station load, the double current machines will avoid a large capacity in rotary converters. The use of double current main dynamos does not change the situation as to arc dynamos from that which holds for stations having both direct and alternating current generators. The development of central stations from an electric equipment consisting of dynamos connected directly to supply circuits, has produced, in some instances, combinations of transforming and converting apparatus in a single station, whose high cost and low operative efficiency may well be avoided.

Minimum Length for Bar Winding End Connection.

By Chas. G. Simonds.

DYNAMO and motor builders in general have much annoyance in joining the ends of bar and form wound armature coils. The common methods employed is either to let the armature winder "cut and try," or the draughtsman lays out a full-sized view of the end of the armature showing the position of the slots, then cuts a paper templet which he thinks about the right shape for a coil end, moves the same about the centre successively from slot to slot, and if found necessary changes the templet and tries again. The

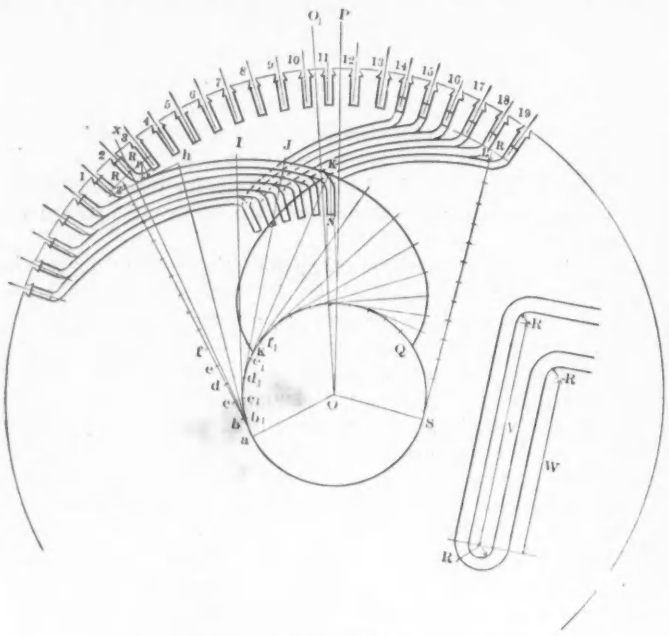


DIAGRAM OF BAR WINDING END CONNECTIONS.

purpose of this article is to demonstrate a method by which any end connection of this form can be designed correctly so as not to interfere and have the shortest length possible.

With the ratio of the width of slot to the tooth pitch used in well designed machines, to make the shortest end connections possible they should completely fill the space which they overspread. It is not necessary here to prove this, neither is it necessary to prove that the proper curvature to nearest accomplish this is that of an involute of a circle about the centre of the armature. It suffices here to show how to construct this involute and use it.

The first thing to do is to find the diameter of the circle which will give us the desired involute. Having drawn the end view of the bars or the coils (if it is form wound coil) in position in the upper part of slots Nos. 1 and 2—or rather, having drawn the end of the end connection in this position, giving it a thickness a trifle greater than outside of the insulation—from points R and R, having relatively the same position with respect to the slots 1 and 2, draw the arcs of circles showing the inside of end connection of No. 1 and the outside of end connection No. 2 as they will appear when bent. This bend should be as short as practicable, depending upon the size of armature and thickness of material. Draw the line gh tangent to these arcs, which points of tangency will represent two points on the involute. These points are so near together compared with their distance from the generating circle that it will be correct to assume that a line xa, drawn perpendicular to gh, and bisecting the distance between these points will fall on the desired circle. About the centre O, draw a circle such that xa will be tangent to it. Draw a line through ga also tangent to the circle. Divide the circle and this line into parts, making $ab = ab'$, $bc = bc'$, $cd = cd'$, etc. With radii equal to gh, gb, gc, gd, and from centres a', b', c', d', draw the arcs gh, hi, ij, jk, etc., which will give the involute gq.

Of course, it is not necessary to draw the lower part of the curve, which will be the form of the outside portion of the end connection. The inside portion or the portion nearest the armature, is drawn in precisely the same way by drawing from L to involute LK. The two curves will intersect at K, where the coil is bent down far enough to make a half turn on itself connecting the inside and outside portions. It will be noted that they do not, as might be supposed, intersect midway between slot No. 1 and slot No. 19. If N should come inside of the generating circle, it shows that the slot is too wide compared with the pitch to be wound in this form.

Telephonic Development in Japan.

In the matter of telephonic development, Japan compares very favorably with Occidental countries; and the service, which is in the hands of the government is said to be progressive and well managed. Several of the cities have a large number of subscribers. Tokyo has about 5000, with some 4000 applications on file at last report; and the new central exchange there is designed for an ultimate capacity of 6000. Last year the subscribers in other cities were returned as follows: Osaka, 1600; Yokohama, 1002; Nagoya, 350;

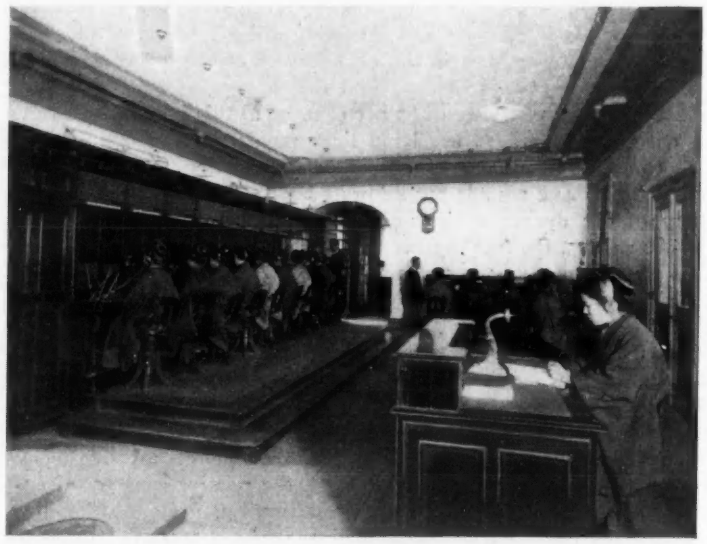


FIG. I.—BRANCH SHIMBASHI TELEPHONE EXCHANGE, TOKYO.

Kyoto, 520; Sakai, 170; Kobe, 843. Through the courtesy of Mr. W. J. Johnston, who has now nearly completed his tour of the world, we are enabled to present views of three of these exchanges, supplementing the pictures given last year in the articles from the Far East by Prof. F. B. Crocker. The new Tokyo main exchange and the Shimbashi, principal branch exchange, of Tokyo, are both excellent illustrations of Western Electric equipment. In the Kobe photograph, we have a type of equipment which even in the United States long since became unfamiliar, although it was once well known—the old Law board, main features of which were the separate calling wire, and the horizontal arrangement of the board, the plugs being inserted from above vertically, with what was then regarded as remarkable economy of labor, space, etc. Professor Crocker in describing this exchange recently in a lecture, with its pretty little girls in their

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quaint dresses around the old fashioned boards, compared it to a "pink tea."

The telephone subscription rate at Tokyo is $33 a year, and the number of local messages last year ran over 15,000,000. The exchange has about 900 miles of aerial wire, and the pole lines are a striking feature of the city, their height and bulk contrasting with the little low houses along the streets. Nagoya may be mentioned as an instance of a smaller exchange. With 350 subscribers, as above stated, there were at the last report 600 more awaiting service. There were then five operators furnishing an average of about 11 connections per day per subscriber. There were 58 miles of metallic circuit, and the subscription rate was $28 per year. For the new exchange, a latest type multiple board is being supplied. The subscribers are furnished with solid back transmitters and many of the overhead circuits are now being replaced by underground cables.

Professor Crocker reports that when he was in Japan considerable work was being done with a view to long distance extensions; and as it is, there is a large amount of toll line work. According to figures quoted in these pages last December, the number of toll line long distance connections during the 11 months ended February, 1899, from Tokyo, were: With Osaka, 11,971; Kyoto, 2211; Sakai, 562.

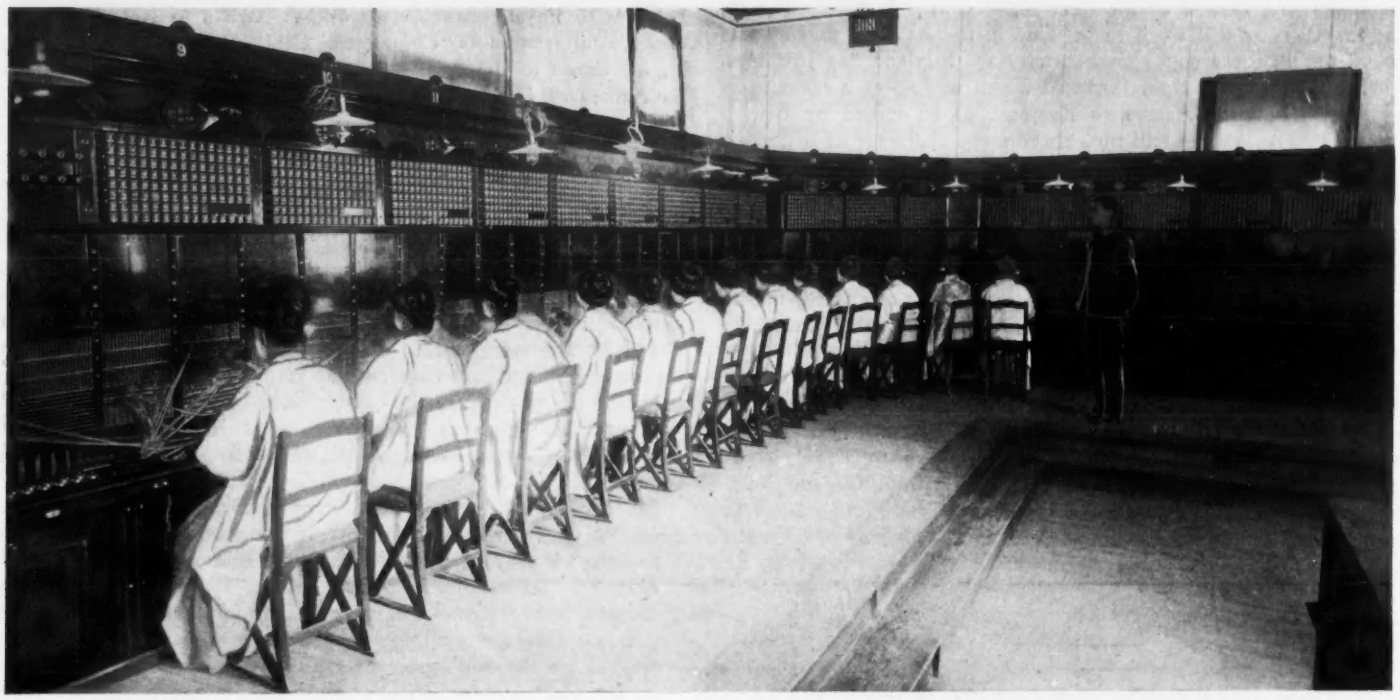


FIG. 2.—MAIN TELEPHONE EXCHANGE, TOKYO, JAPAN.

As already indicated, this country has been freely resorted to by the progressive Japanese for telephone apparatus, cables, etc., and the fact that the government is spending $1,000,000 on new telephone work this year would imply that the demand continues. In fact, Japan, like all other eastern countries, is a favorable soil for telephone growth, and has in addition a spirit of progress peculiarly its own, one evidence of which is rapid electrical development.

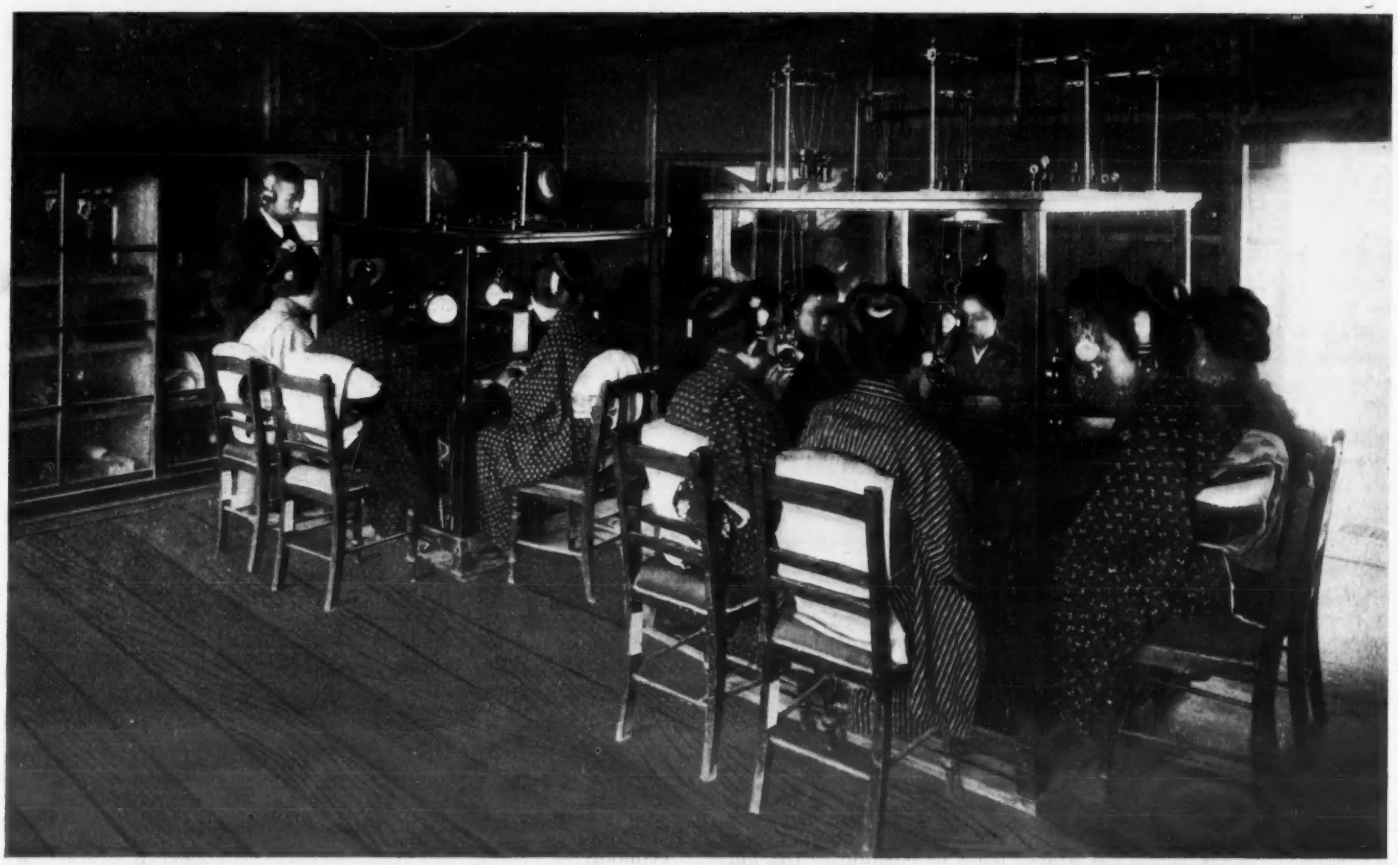
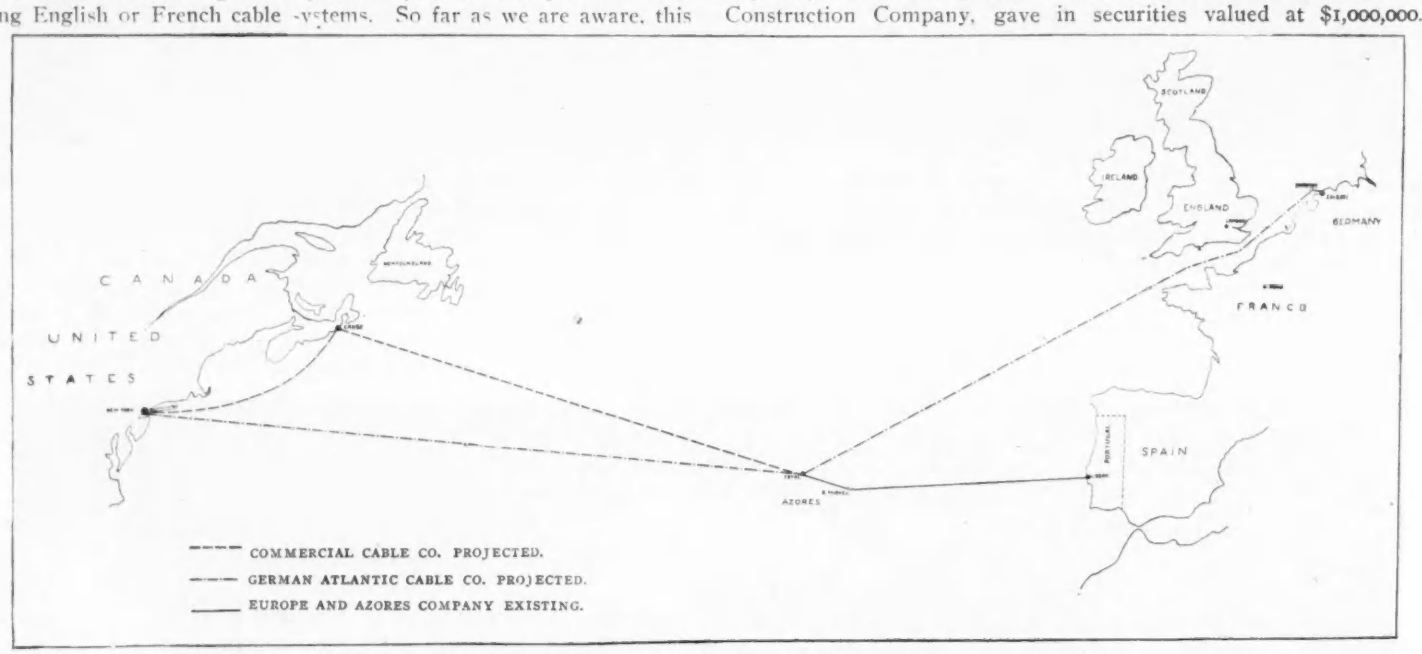


FIG. 3.—ORIGINAL LAW SYSTEM TELEPHONE EXCHANGE, KOBE, JAPAN.

The Projected German-American Cable.

It is very often assumed that the development of cable laying in the North Atlantic has reached its end, and that the present cables will suffice for the work and business offering. It is also publicly supposed that activity is to be transferred forthwith to the Pacific, and that that ocean is to be the scene of submarine cable operations during the first decade of the next century. As a matter of fact, however, there is still work to be done in the Atlantic, and as was pointed out in these pages on February 17, England has just been securing a concession from Portugal which will allow a cable to be laid direct from the Azores to England, to be served by British operators. The Azores will thus assume the character of a lookout point for the British navy. It will be remembered that during our own war with Spain, the existing cable connections with the Azores proved to be very inadequate, so that our own interest in work of this character is by no means slight or small. Germany also has a deep concern in new plans for cable laying in the Atlantic and proposes to subserve the interests of her navy and her mercantile marine by an independent German cable running directly, via the Azores, from her own coast to ours.

We present herewith a map, which we believe illustrates for the first time the existing situation and shows the various projected lines. It will be seen that the route of the new German Atlantic Cable Company runs directly from New York to Fayal in the Azores and from that point direct again to Borkum, Germany, thus avoiding the English coast on one hand and the French coast on the other, and avoiding also any necessity to utilize any of the existing English or French cable systems. So far as we are aware, this is the first cable which will traverse the English Channel from southwest to northeast, and it is obvious that in doing so it must cross several of the continental cables at right angles. Furthermore, it will be seen that the Azores are to be connected with the Commercial Cable Company's lines at Canso, Nova Scotia.



MAP SHOWING ROUTE OF PROJECTED ATLANTIC CABLES.

We understand that the contracts for all this important new work were let some time ago, and that these new cable routes will be available and in operation within the next six months. It is said that the new German company will be operated in close affiliation with the Commercial Cable Company, which in turn connects closely with the Postal Telegraph lines and with the Canadian Pacific Railway telegraph lines in Canada. The Commercial Cable Company, as is well known, is a distinctively American enterprise, but its securities are largely dealt in at Montreal and enjoy the confidence of the Canadian financial market.

A great deal of interest attaches to the question of the relations that will subsist between the new German cable company and the present North Atlantic cable pool. It is obvious that the business between Germany and this country is a large slice of the existing traffic, and that while considerable new patronage can and will be developed by the new service, it would be to the interest of those in present control of the cable situation to maintain rates upon an equitable and profitable basis. Be this as it may, great benefit must be derived by the public from the enterprise of those who are creating these new cable facilities, if only from the fact that another alternative route is presented, rendering cessation of communication between this country and Europe more than ever impossible, and giving us instantaneous commercial touch with a section of the Atlantic in which our interests are growing rapidly.

The lengths of the projected cables are as follows. German cable, Borkum to Fayal, Azores, 1875 knots; Azores to New York, 2320 knots, total 4195 knots; Commercial Cable, New York to Canso, 870 knots; Canso to the Azores, 1670 knots; total from New York to the Azores via Canso, 2540 knots.

The New York Electric Underground Railway.

Mr. John B. McDonald, the contractor, and the members of the New York Rapid Transit Commission, affixed their signatures on February 24 to the contract for the construction of the underground rapid transit railroad, which is to cost the city $35,000,000, and which is to extend from the Post Office to Spuyten Duyvil Creek on the west and to Bronx Park on the east. It was the largest single contract ever entered into by an American city, and probably by any city in the world. The building of the main tunnel is looked upon as merely the beginning of a great system of underground roads which will knit the five boroughs of the city together.

Mr. McDonald gave in a check for $1,000,000 as the cash deposit required, and Mr. August Belmont, as president of the Subway Construction Company, gave in securities valued at $1,000,000. In addition the company filed a bond for $4,000,000, and an additional bond of $1,000,000 was filed by surety companies. It is stated that the entire issue of $35,000,000 of bonds by the city required for the tunnel railway by the Rapid Transit Commissioners will be authorized at once by the Board of Estimate and Apportionment. Work begins within thirty days.

It is a settled conviction in the minds of some men of affairs that the Metropolitan Street Railway Company will operate the rapid transit railroad under the contractor's fifty-year lease. Albert B. Boardman, of counsel for the Commission, said: "I think I am violating no confidence when I say that the Metropolitan Street Railway Company is the natural operating company for this road. It occupies the best position to operate and get the best results out of the tunnel. The Metropolitan's lateral lines make the tunnel more valuable to it than to any other company. A law of gravitation will make this lease fall into the hands of the persons most fitted to use it—the Metropolitan Street Railway Company."

The statement thus made by Mr. Boardman, that the tunnel road when built will be operated by the Metropolitan Street Railway, has not met with a ready response from those in control of the road. Mr. William C. Whitney, when asked about it denied any present interest on the part of the Metropolitan.

American Electrical Engineering Standardization.

BY C. F. GUILBERT.

THE report of the Standardization Committee of the American Institute of Electrical Engineers has excited much interest in Europe, for it answers to a very real need. The progress in electrical applications has been so rapid in the past ten years that only those professionally identified with the art have been able to follow closely its advances. As to the purchasers, and even users of apparatus, their knowledge as to the current state of the art and the requirements they should ask in new apparatus, has generally been limited to the circulars and instructions furnished by manufacturers. For these the drawing up or the discussion of specifications has become a serious difficulty which can only be surmounted by placing within their reach a set of rules specifying what requirements apparatus should fulfil.

Manufacturers have themselves an equal interest in the existence of model specifications, for by specifying in a perfectly definite manner the methods, always the same, which should be employed in determining the value of apparatus furnished, a comparison is rendered possible between the products of different manufacturers—a comparison difficult to make if each manufacturer employs different methods.

The report of the Committee of the American Institute of Electrical Engineers accomplished well the purpose it had in view. The only general criticism one can offer is that some of the methods of testing indicated are not sufficiently clearly defined, which lack of definiteness leaves the field free to misinterpretations on the part of the reader. In a previous article, printed elsewhere and noted in these pages, the writer has criticised certain details of the report. It is his intention here to cover the same points, but with especial stress on those which appear to have the most importance, adding some remarks which have been suggested by a closer study of the question.

CLASSIFICATION.

The classification of machines presented by the committee is very satisfactory to the writer from the scientific point of view, but appears to be open to objection in two respects—by omitting the class of unipolar dynamos which is of considerable interest though not represented by many applications; and by omitting laminated field, commutator alternating-current motors—shunt or series. These motors are commutator machines, and though operating only accidentally at the speed of synchronism, none of their properties are thereby modified from a mechanical point of view—that is, there is no discontinuity or change of sign in their couples, as is well shown in the theory of this type as laid down by Steinmetz.[1]

To these criticisms may be added two others. In the first place, Class III., comprises phase converters and frequency converters, though the latter do not have commutators if the apparatus be separately excited. In the second place, phase transformers should figure normally, not in a single class, but, according to their nature, in three classes, as follows: In Class III. as synchronous apparatus, in the case of synchronous converters; in Class V. in the case of phase transformers of the non-rotating type (transformers of Dobrowolsky for triphase-hexaphase transformation, Scott and Leblanc transformers); and in Class VI. in case of non-synchronous transformers, such as those of Potier, Ferraris, Arno, etc.

In another order of ideas, a classification of machines which does not indicate definitely a separation between the continuous and alternating current has, in my opinion, little chance of success with those engineers who are little acquainted with the higher theory of electrical machines. For such as these, absorbed as they are in other lines of work, there is necessary what may be termed a classical classification—one somewhat out of date, to employ the proper expression; that is to say, the old division of machines into continuous-current and alternating-current machines.

To these two general classes of machines—of which the first has nevertheless been subdivided, according to usage, into machines giving practically continuous current and those giving pulsating current—has been added a third class of machines already well known to the general public—that of rotary converters; or, in an order of ideas still more general, polymorphic apparatus of which double-current generators constitute the most interesting example, and which comprises also the entire series of apparatus for converting monophase or polyphase currents into continuous currents or alternating currents of a different number of phases.

In view of the above, the following classification is presented, naturally, however, without any claims as to novelty:

I. *Continuous Current Apparatus.—a.* Continuous-current dynamos and motors; converters or motor-generators, dynamotors and boosters. *b.* Rectifying machines. *c.* Commutatorless dynamos.

II. *Alternating Current Apparatus.—a.* Synchronous alternators and motors. *b.* Induction alternators and motors. *c.* Laminated field alternating-current motors. *d.* Static transformers.

III. *Polymorphic Apparatus.*[3]*—a.* Polymorphic generators. *b.* Polymorphic static transformers. *c.* Polymorphic transformers with moving parts and converters.[4]

Certain apparatus of Class II. are, compared with those of Class III., monomorphic—that is to say, furnish but one kind of energy.

This classification, as stated above, would be somewhat out of date in the scientific world, but is much more suitable than a more scientific classification with respect to the electrical industry in general.

EFFICIENCY.

The true efficiency as defined by the committee—the ratio of the net power output to the gross power input—is difficult to measure in many cases and particularly so in the case of a generator, on account of the difficulty in determining the mechanical power transmitted to the pulley, to the shaft if direct connected, or when dealing with apparatus of considerable power. The impossibility of measuring this true efficiency leads to the adoption of a method for obtaining an approximate value, an indirect method well known among electricians by the name of the method for separated losses. When the determination of the true efficiency is considered to be impossible, a well-defined distinction should be made between the true and the approximate efficiency by applying to the latter a special designation, such as conventional efficiency, for example.

Evidently the method employed for the measurement of this conventional efficiency should be the same for an entire class of apparatus, and should furnish a value as close as possible to the true efficiency. That is to say, nothing should be neglected in the determination of individual losses, and particular account should be taken of the increase of losses with increase of load due to journal friction, belt tension, gear friction, etc., all of which losses the committee ask us to neglect.

The tests that have been made within a recent period for the determination of the journal friction losses of dynamos, in which account has been taken of the nature of the frictional surfaces, the temperature of the lubricant, the linear velocity of the surfaces, the pressure per unit surface of bearing, etc., are sufficiently concordant to admit of a table of coefficients being compiled. Such a table, were it even only roughly approximate, would always enable account in a certain measure to be taken of the losses at full load, by calculating such losses upon a well-defined hypothesis—or example, by assuming that the tension on one side of a belt is double the tension on the other, and that the shafts of the electrical apparatus and those of the apparatus driving or driven are in the same horizontal plane.

Still simpler, we may be contented to determine the coefficient of shaft friction of the machine under test at no load run as a motor, by a method to be indicated below, and to use the coefficient thus obtained for the calculation of load frictional losses on the hypothesis mentioned above. This latter method assumes, of course, that the frictional losses depend only on the nature of the frictional surfaces and the lubricant, and on the linear journal velocity; but it is readily seen that the coefficient thus obtained will lead to a value of conventional efficiency closer to the true efficiency than when account is not taken of the losses mentioned.

In the same order of ideas, when a dynamo is mounted on the same shaft as the motor which drives it, the losses by friction and ventilation cannot be neglected unless it is definitely specified that the conventional efficiency of the dynamo is nothing but its electrical efficiency. However, in order to take account of the frictional losses so as to cause the conventional efficiency to approximate to the true efficiency, a first approximation to these losses can always be obtained as in the case of a dynamo belted or geared, by disconnecting the primary motor and driving the dynamo either by means of an electric motor, which in some cases may be its own exciter if the machine is an alternator, or in causing it to operate as a direct-current or an alternating-current motor.

[1] "Alternating Current Phenomena," 2d edition.

[2] See E. Hospitalier, *Industrie Electrique*, No. 58, p. 213, 1894.

[3] The word "converter" thus designates an apparatus with moving parts, and is therefore used in a sense more general than by Prof. Blondel (*Lumiere Electrique*, tome III., p. 519, 1894).

The losses from friction and ventilation can, if desired, be separated from the losses by hysteresis and Foucault currents by a method which will be described later. This method perhaps presents some difficulties in the case of alternators, on account of the possibility of an alternator falling out of synchronism when operating as a synchronous motor at a small voltage as compared with the normal voltage; but this difficulty is not insurmountable experimentally, as we know from the result of frequent trials.

Frictional and ventilation losses of direct-driven dynamos ought not evidently be charged to the dynamo instead of to the engine; the manufacturers of primary motors, besides, have never intended that they should not bear the frictional losses of their own machines. Rigorously, then, we can adopt the standpoint of the committee, but in so doing should definitely specify the efficiency as merely electrical efficiency, the experimental measurement of which by the method of stray losses requires that the frictional and ventilation losses be separated from the hysteresis and Foucault current losses.

Though the instructions given in the report are correct, it seems to us that they might be rendered still more definite and complete. It is, for example, far from rigorous to content oneself with a single test for the no-load losses, as it is always a delicate matter to work at a selected voltage. In order to obtain these losses to as close approximation as is desirable, we personally use a method—one not unknown in the electrical laboratory—which consists in constructing for the machine to be tested and which is made to work as a motor, a curve of no-load losses in terms of voltage at binding posts and for constant speed. This kind of test is always made after a run of a certain number of hours at full load in order that the journals, and, as far as possible, the machine, shall have reached a normal temperature. This curve may be constructed for voltages not only in the vicinity of the normal voltage, but also for the lowest possible voltages, so as to enable the curve to be continued to the power axis for use in determining the frictional and ventilation losses on the natural assumption that these losses remain constant with the speed. The adjustment of the speed is made by means of rheostats with many subdivisions, or better, by means of a liquid rheostat; the employment of a tachometer is necessary for quickness in adjusting the speed. When a carefully calibrated motor is available, the method can be preferably used previously referred to, of driving the dyanmo and measuring the frictional and ventilation losses and those produced by increasing excitation.

The two methods give results very concordant, but the second is more rapid of execution. The curve once laid down, there can be taken from it the power consumed at no load for a given voltage.

To increase the precision of the method of measuring the efficiency, the committee proposes to take account of supplementary losses called "the load losses." The definition of these losses—the difference between the total real loss and the sum of the individual losses—is incorrect, for thus defined, they include also the increase of losses by journal friction, belt tension, increase of gear friction, etc. The method employed to determine them approximately does not seem to us one very practicable in the case of commutator machines; moreover, if the machines have metallic brushes, it is well to recognize that it is always difficult to obtain the losses in a manner even roughly approximate by any simple indirect method.

As we have stated above, all the instructions and remarks in the report concerning the true efficiency, or lacking it, the conventional efficiency, are correct. There is, therefore, no criticism to make as to details. On two points only our opinion differs from that of the committee with reference to the definition of the true efficiency of a given class of apparatus.

The first point is relative to the efficiency of alternators. It is not possible to admit that the true or the conventional efficiency may be determined with a power factor equal to unity, as such an efficiency is always larger than that corresponding to a power factor determined for a same number of kilo-volt-amperes, for the reason that the armature losses remain the same though the true power be diminished proportionately to the value of the power factor, and especially for the reason that the field losses are increased. The efficiency upon which the user should count for an alternator of a given apparent power in kilo-volt-amperes will thus always be less than if measured according to the direct or indirect method given in the specifications. What interests him particularly is the efficiency which he will obtain at full load in practical operation.

Unless using over-excited synchronous motors with alternators giving perfect sine curve variations of voltage and working with apparatus which will not deform the current curve, the power factor of the distributing system will never be equal to unity even practically. Another consideration more important is, that the alternator can easily give a true power of 1000-kw, for example, with non-inductive resistances, when it could not give an apparent power of 1000 kilovolt-amperes on an inductive resistance having a power factor of .5, for the reason that the increased excitation necessitated might be beyond the limits of the design of the machine.

What the user asks is that the alternator shall work under the specific conditions with respect to the circuit on which it will be installed, and not with respect to a special circuit. The manufacturer, therefore, must know *a priori,* the power factor of the system on which an alternator will work, and similarly it would be to the interest of the user to know the efficiency of the alternator under the same conditions and be enabled to assure himself that it will fulfil the requirements he has laid down; that is to say, if it can supply the apparent power corresponding to the power factor specified. It may be objected that modern alternators have in general considerable margin with respect to excitation, and that many are designed to furnish the apparent power for which they are intended with any power factor whatever, however small it may be. But certain classes of alternators, as, for example, those of low voltage used by manufacturers of calcic carbide, have generally a large drop and necessitate a large increase of excitation as the power factor of the working circuit becomes smaller by reason of the impedance of circuits carrying large currents.

All these considerations lead manufacturers to require the specification of the power factor to enable them to guarantee the efficiency of an alternator for a given apparent power with a power factor also given. They may also—as is often done in France—supply not only a guarantee of efficiency for the given power factor, but in addition a guarantee of efficiency for a power factor of unity.

The second difference of opinion relates to the determination of losses at the commutator from the joule effect. The committee is open to criticism from having adopted the figures of Steinmetz, based upon the hypothesis of the sine law, which hypothesis is inadmissible as it is never realized. It is but fair to say, however, that the figures given by Kapp and based upon the law of flux division, also depend upon the sine-curve hypothesis; this hypothesis not being compatible with that of a flux following any other periodic law, the figures of Kapp are probably no more exact than those of Steinmetz. The latter being the larger, are preferable to the former from the standpoint of the user, but not from that of the manufacturer.

If one wishes to take account of the power factor, the coefficient to use in order to obtain the losses by the joule effect are, both in the theoretical case of sinusoidal division of flux and in the case investigated by Kapp, those given by us in these columns.[4]

RISE OF TEMPERATURE.

To determine the temperature of a given winding the committee proposes the following formula for use:

$$R_T = R_t\,(1 + .004\,\theta).$$

This formula is not absolutely correct, even taking account of the accompanying corrections when the temperature during the test is not equal to 25 degrees. It appears to us much more rigorous to first reduce the resistance measured cold at the temperature t, to its value at zero by the formula

$$R_o = \frac{R_{t\,t}}{1 + a\,t_1};$$

or for still greater exactness, the mean value of a between 0 and t, may be taken from a table. The mean temperature of the winding can then be calculated from the formula

$$R_x = R_o\,(1 + a_1\,x).$$

If still greater exactness is thought necessary, an approximate value can first be given to a_1, the mean coefficient between 0 and 70 deg., for example; then the value of x may be deduced, a second value of a_1 next assumed, and in this manner a final and very close value of x obtained. The value most commonly used in France for the coefficient a is .00388 or .0039. In tests for heating as in those for determining the losses at no load, it is well not to be contented with a single measurement of resistance. It is also advisable to interupt the test hourly, for, example, then make measurements as rapidly as possible; a curve representing the values of resistance in function of the time will show when the normal temperature is established and thus give great exactitude to the test. As in the determination of the resistance cold, the measurement of which is always difficult, the use of the curve representing the rate of decrease

[4] ELECTRICAL WORLD, May 20, 1899, p. 659.

of resistance during the test as a function of the time, will be useful. It is important also that the resistance be always measured under the same conditions. To accomplish this in the case of commutator machines, some manufacturers put small binding posts on two segments of the commutator.

The maximum values given by the committee for the rise of temperature for the several parts of an electrical apparatus are, we think, a little too condensed. It is, in fact, evident that a machine insulated with micanite can support a temperature higher than one insulated with paper or with cloth. Similarly a field coil not interiorly insulated can only support a temperature much lower than one which is insulated with shellac or varnish. Nor is it possible to admit the same limits for rise of temperature for oil transformers as for transformers of the usual air-cooled type.

INSULATION, REGULATION, VARIATION AND PULSATION.

The value of the ohmic resistance of insulation appears to us too small, but it is true to say that this resistance is of secondary importance compared to the resistance to rupture by high voltage. Tests made with high voltages are very advisable, as they permit faults to be located that would be very difficult to find otherwise.

The testing voltages proposed by the committee are very acceptable, though very far from those laid down by Prof. Jackson for transformer tests, which latter, however, are too high. We approve equally without reserve the sections on the definition and measurement of inherent regulation. We would, however, have been glad to see a table included containing the maxima and minima limits that can be admitted for coefficients of regulation for different classes of electrical apparatus, taking account, of course, of the power factor. The employment of the words "variation" and "pulsation" to define the periodic angular displacement of the revolving member and its rate of variation, $\frac{\text{V max.} - \text{V min.}}{\text{V max.}}$ does not appear to us to be very happy, the word "variation" having a sense too general and the word "pulsation" being already employed, in French at least, to designate another quantity. In electrical engineering these words appear to us still less acceptable, but this is a matter of terminology, which it would be out of place to discuss here.

RATING.

The considerations which we have given above on the subject of the specification of the efficiency of an alternator as a function of the power factor, also apply here. The user would much rather know the apparent power which an apparatus can supply to a given circuit—that is to say, a circuit having a given power factor—than to know the power which the same alternator may give connected to non-inductive resistances—that is to say, in a laboratory test. The current which a machine can give is, in fact, the most interesting point for the user to know, and a knowledge of the apparent power in kilovolt-amperes is, therefore, desirable. It is especially advantageous to the manufacturer for reasons which we have given, to have designated the minimum power factor for which the machine is to be designed. This amounts to designating the true power of an alternator in kilowatts together with a statement of the available power factor. These remarks are evidently also applicable to transformers, and in general to all alternating current apparatus.

The consideration of the apparent efficiency of an alternating-current apparatus having phase displacement appears to us, for reasons of simplicity advanced at the beginning of this article, not to be desirable. This may lead to confusion, and it is better for the specifications to specify a single efficiency, which naturally should be the true efficiency, or, lacking that, the conventional efficiency. The same remarks may be applied with respect to the inductance factor, the definition of which becomes difficult when neither the voltage nor the current follow the sine law. It has an interest, therefore, to scientific electricians, but not to the user of electrical apparatus in general.

Such are the criticisms which we have to make on the report of the committee of the American Institute of Electrical Engineers. As may be seen, they relate merely to matters of detail and have all the same end—the greatest exactness possible in the methods followed. Definite specifications and definite methods for employment to determine if the conditions laid down by a specification are fulfilled, will render impossible all dispute. However that may be, the work of the American Institute of Electrical Engineers has a high value, and if it be not adopted in all of its details by other countries, it will undoubtedly serve as a basis for all work of the same kind.

Electric Light and Railway Earnings in England.

A number of the electric lighting companies, more frequently called "electricity supply corporations," in London, have been making their annual statements, most of which are quite satisfactory. The Charing Cross and Strand Electricity Supply Corporation have declared a dividend for the half year ending December, 1899, at the rate of 10 per cent. per annum which, with previous dividends, makes a dividend for the year 1899 of 9 per cent., being 1 per cent. more than the previous year. This company has put up its dividend 1 per cent. annually since 1895. In addition to this dividend it has provided £8,000 for depreciation and carries forward £4000. The Westminster Electrical Supply Corporation has declared for the entire year a dividend aggregating 13 per cent., which is also an increase of 1 per cent. upon the previous year. The Kensington and Knightsbridge Electric Lighting Company declared a dividend of 10 per cent. per annum for the first half year of 1899, and have now declared a further dividend of 6 per cent. for the past half year, making with the interim dividend 11 per cent. for the year. In addition they have strengthened the renewal account of £4764, making a total now placed to that account of £30,379, and in addition carry forward £4093. The Cambridge Electric Supply Company are paying 7 per cent. for the entire year and have placed £750 to depreciation account and are carrying forward £233. Some of the other companies are not quite so successful, but on the whole the reports show that the electric lighting business in London, when well managed, is successful and remunerative.

Turning for a moment to the underground railways, the City and South London Railway Company have had to reduce their dividend to 1½ per cent. This is largely owing to the extensions which this company is completing, and as it is well known they are building a large central station at Clapham and extending the route through the city under Moorgate street to Islington, all of which has required new capital, and has consequently reduced the dividend for the time being. The Waterloo and City Railway are in a fortunate position, as their dividends are guaranteed by the London and Southwestern Company, this underground railway being run as a feeder to the railway company. The gross receipts for the past half year amounted to £13,348, from which the London and Southwestern Company deduct £4824 for working expenses, leaving £8524 to provide a dividend of 3 per cent. per annum on the company's ordinary and borrowed capital. The number of passengers carried during the past six months was 1,769,731.

Jacques-Cartier Transmission Plant, Canada.

A new electrical power plant of a highly interesting nature is rapidly approaching completion at St. Gabriel, P. Q. The Jacques-Cartier Water Power Company utilizes a fall of thirty feet in the St. Gabriel River, which occurs in a rapid 200 yards in length. The current will be transmitted to Quebec, eighteen miles distant, at 20,000 volts, for lighting and power. A dam 300 feet in length, of stone foundations and abutments, with a wood superstructure, has been constructed near the head of the rapids. A penstock carries the water for a distance of 200 feet below the dam to the power house, which has been built in a depression near the river.

Some months ago the International Hydraulic Company, of Montreal, contracted with the Westinghouse Electric & Manufacturing Company for a complete electrical equipment, which is now in course of erection at St. Gabriel. Two 750-kw Westinghouse three-phase generators will be direct-connected to water wheels, and wound for a normal e. m. f. of 2000 volts, and a frequency of 7200 alternations per minute at a speed of 150 r. p. m. The arrangement of circuits is so designed that the two generators may be operated in parallel as well as independently. They are guaranteed to run continuously for twenty-four hours at their normal output of 750-kw, with a rise in temperature not to exceed 35 degrees C. above the temperature of the surrounding air, and also to run continuously for twenty-four hours at 938-kw output, with a rise in temperature not to exceed 45 degrees C. The commercial efficiency of each generator is guaranteed to be, at full load, 94 per cent. At 50 per cent. overload the commercial efficiency shall not fall below 93 per cent.

There have been provided for exciting purposes two 37½-kw Westinghouse multipolar generators, of 125 volts, at 350 r. p. m.,

direct-connected to smaller water wheels. Each of these machines is designed to fully excite the fields of both generators when they are developing 938-kw each at a power factor of 90 per cent. The transformer room runs the entire width of the power house, having a depth of 24 feet 10 inches, and will contain six 250-kw Westinghouse self-cooling, oil-insulated transformers, to raise the 2000 volts from the generators to 20,000 volts three-phase, at a frequency of 60 cycles per second. The switchboard is built in accordance with the usual Westinghouse practice, and consists of two generator panels, two circuit panels, and one exciter panel. The switchboard is mounted on a gallery which extends from a wall, running across the full width of the building, directly in the center of the power house, so that it is placed very favorably with regard to connections with the generators and exciters. The cables will be run through ducts built in the cement floor. The generator feeder and exciter panels carry the usual instruments for controlling and metering the current. The plant will be protected by twelve Wurts non-arcing metal lightning arresters and choke coils, three at each end of each of the two three-wire transmission circuits. The current at 20,000 volts will be transmitted from the St. Gabriel transformer house to Quebec, a distance of eighteen miles, by overhead wires. The line is constructed in two distinct circuits, each of three wires for three-phase transmission, with the three wires of each circuit equally distant one from the others, the spacing being eighteen inches. The substation in Quebec to which the transmission lines carry current will contain four 375-kw Westinghouse transformers of the oil-insulated and self-cooling type, to step down from 19,000 volts to the voltage required for the distributing circuits. The transformers will be arranged in two groups of two each, connected on the "Scott" system, to receive three-phase current at the primaries and deliver two-phase current from the secondaries.

Work at the St. Gabriel power house is being rapidly pushed on. The water wheels are already in place and the electrical machinery is in course of erection. It is anticipated that everything will be completed for the transmission of current to Quebec in the coming spring.

Independent Telephony in Wisconsin.

The Oshkosh Northwestern Telephone Company became the property of the Erie Telephone Company on Feb. 7. The deal was on for days, but was not closed until then. The Erie Company was represented in the negotiations by J. H. Pettingill, of Lowell, Mass., vice-president of the Erie Company; John D. McLeod, of Milwaukee, general manager of the Wisconsin Bell Telephone Company, and B. K. Miller, attorney, of Milwaukee. While the actual acount involved in the transfer is not made public, it is announced that the local company has expended close to $40,000 since installing its system five years ago, and in only one year during that time has a dividend been paid to the stockholders, and was for 4 per cent. The price received for the system is admitted to cover all outlays made by the local people in the five years, with a fair rate of interest for their money invested. By the terms of the sale the Wisconsin Telephone Company agrees to carry out all contracts existing between the Northwestern Telephone Company and the public, owners of poles and the City of Oshkosh.

The Wisconsin Company has also leased the exchange quarters of the Northwestern Company until Sept. 1, by which time it is hoped the new building of the Wisconsin Telephone Company will be ready for occupancy. The two exchanges in the city will continue to be occupied until then. The removal of the Northwestern telephones, however, will be begun shortly and replaced by the instruments of the Wisconsin Company. In fact, the work of transferring the 1000 subscribers of the two exchanges to the Wisconsin system will be pushed rapidly. It is probable that the quarters of the Wisconsin Company in the Algoma block will be utilized for the toll or outside connections, and all local business may be transferred to the Jewell block, in which the Northwestern exchange is located, until the new exchange is ready.

The Northwestern Telephone Company stockholders insisted on the insertion in the sale contract of a clause stipulating that the price to all subscribers for the next five years shall not exceed $36 for business houses and $24 for residences on single wires. This was the bone of contention, and it seemed for a time that negotiations would be at an end between the two companies.

The company was incorporated for $20,000 at $100 a share. The improvements of the exchange, however, have called for an additional $20,000, and it was the intention to increase the capital stock if the present sale had not been consummated. Charles Schriber, treasurer of the Northwestern Company, was named a trustee by the stockholders.

A Novel Automobile for Doctors and Others.

It has been expected that the new automobile art would itself evolve some new types of vehicles, as to shape, size and style, and would also meet some necessities not before satisfied. These expectations are not being disappointed, though it takes longer to go through the evolutionary process than the more sanguine are inclined to believe. Meanwhile, the attempts made to satisfy conditions that are fairly general goes on hopefully and with excellent results.

A decided novelty is the form of doctor's buggy which we illustrate herewith, and which has met with a marked welcome. Its design is due to Mr. Elmer A. Sperry, and it is built by the Cleveland Machine Screw Company. Our cut hardly does it justice, as the photograph was taken from a vehicle in an unfinished state of painting.

ENCLOSED AUTOMOBILE FOR DOCTORS.

This specially designed closed vehicle, for the use of doctors in cold and wet weather, can also be used in summer by lowering the window. Inside is space for instrument cases and other necessary articles of use carried by a doctor. The steering and controlling devices, light switches for side lights, head light and inside reading light, are easily accessible to the driver and occupant. The doors are amply wide for access and egress.

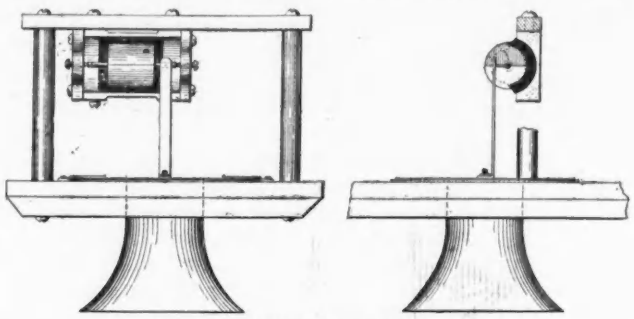
The truck is a standard form of intermediate weight, between the heavy brougham and delivery, and light runabout types. The motor is a three and one-half horse power with very efficient braking devices, which are in complete duplicate systems, one of which is automatic, being applied by operating the handle in the act of throwing off current.

The system of control is of the standard Sperry style with a single handle for all operations, including three speeds forward and backward, braking, steering and coasting. The forward speed can be increased from 10 up to 15 miles, which is thought to be sufficiently high for special purposes of this vehicle. The motor is supplied with standard compound gears for emergency purposes whereby power and leverage over the load can be trebled or tripled at the pleasure of the operator. The electric headlight is automatically swiveled, throwing its beam in any direction in which it is desired to turn the vehicle. The controller is supplied with a key, which performs a number of important functions, namely, backing, running forward and charging, and upon the removal of which the carriage is securely locked and can be left alone in the street with perfect safety. The motor support on this class of truck is special, it being so hung as to entirely eliminate the jerking and reaction of the carriage body at the time of sudden starts or stops.

Some Recent Telephone Patents.

Among the patents issued February 20 are three on telephone improvements, two relating to new types of transmitters. One of these latter—issued to Albert Stromberg—while depending for its operation upon variation of resistance in the circuit occasioned by sound waves, is claimed not to depend upon variation of pressure between the electrodes. Referring to the accompanying illustrations, vibratory motion is given to a cylinder by the vibrations of the diaphragm spoken to. One-half of this cylinder consists of insulating material—the upper or shaded portion in the right hand cut, and the other half of a metal, perfectly gold-plated. The metal part of the cylinder forms one electrode of the circuit, the other electrode consisting of granulated carbon held in place by a plush packing glued to the cavity of the metallic support to the right of the cylinder on the left. The plush confines the granules in place and in contact with the face of the cylinder; the metallic support being in contact with the granules, forms the other electrode.

As the diaphragm is vibrated, the surface of carbon in contact with the metallic portion of the cylinder is varied, thus varying the resistance of the transmitter electric circuit. Moreover, the direction of motion given to the cylinder is such that fainter sounds are accompanied by lower resistance in the transmitter circuit than louder sounds. Among other advantages claimed are



NOVEL TELEPHONE TRANSMITTER.

the carbon granules are less liable to pack, and accidental bucklings of the diaphragm are not so serious in effect as in the case of variable pressure transmitters. The claim is made that this type of transmitter does not infringe the Berliner patent.

The second transmitter patent, issued to C. E. Tucker and L. S. Jenkins, relates also to granular carbon instruments. The granules are contained in a semi-spherical cavity in a carbon block. The opening of the cavity is opposed to the diaphragm, the granules being in contact therewith and prevented from escaping by the clearance between carbon block and diaphragm being made sufficiently small.

A patent issued to Franz Burger describes a method whereby when no answer is made to a call, central can determine if the electric connections and line are in working order. By means of an attachment to the arm of the call bell, the vibrations of the latter cause a pawl to actuate a ratchet wheel and thereby wind up a string attached to its shaft. When the bell ceases to ring, the spring unwinds, works a miniature air pump, thus producing air vibrations which are made to affect the transmitter diaphragm. As the spring mechanism is about to resume its normal position, a change of contacts is made which cuts out the transmitter and restores the circuit to its normal condition.

CURRENT NEWS AND NOTES.

SWITCHBOARD INSCRIPTION.—According to our contemporary, the London *Electrical Review,* there is a switchboard on the continent which has the following inscription: "Think which, then switch."

PACIFIC CABLE.—On Feb. 20 Mr. Joseph Chamberlain said in the House of Commons that he understood the committee in charge of the Pacific cable matter would soon report. It is stated that Canadian opinion is aroused over the grants of terminals by the antipodean colonies.

NATIONAL ELECTRIC LIGHT CONVENTION.—The Central Passenger Association has granted a special rate of a fare and one-third, on the certificate plan, from all points in the territory to Chicago and return, for delegates and friends attending the twenty-third convention of the National Electric Light Association, to be held in Chicago, Ill., May 22, 23 and 24, next. It is expected that the various other passenger associations will announce the same concession at an early date.

COMMISSIONER PECK, of the Paris Exposition, has sailed for Europe with several members of his staff, including Assistant Director Anthony, of the Department of Machinery and Electricity. Mr. Peck has hit upon the idea of sending to Paris a number of young American college students to serve as guides, interpreters and guards. This strikes Parisians as an interesting idea and a good one, while the Exposition authorities regard it as another example of American originality. Almost a dozen of the young Americans have arrived and are busy.

INDEPENDENT TELEPHONE ASSOCIATION.—The Independent Telephone Association of the Carolinas was organized at Charlotte, N. C., on Feb. 15. The following named gentlemen were elected officers: President, W. B. Moore, of Yorkville, S. C.; vice-presidents, C. Edwin Fleming, of Spartanburg, S. C.; and R. D. Babington, Gastonia; secretary, J. C. Mills, Rutherfordton; treasurer, J. A. Martin, Hickory, N. C.; executive committee, John W. Simpson, Spartanburg, S. C.; E. L. Moore, Dillon, S. C.; J. A. Helvin, Charlotte, N. C.; Dr. M. C. Hunter, Stanley Creek; A. C. Shuford, Newton; attorneys, T. C. Guthrie, Charlotte; J. S. Brice, Yorkville, S. C.; electricians, C. E. Bradshaw, Charlotte, and F. C. Manning, Sumter, S. C. The organization represents 3466 independent telephones and 1479 miles of telephone lines in North and South Carolina.

AUTOMOBILE WEEK AT PAU, FRANCE.—The city of Pau was the centre of a grand "Automobile Week" commencing Feb. 22. The Automobile Club Bearnais arranged for a varied programme of motor events on these dates including a tourists' contest on a course some 90 miles long, beginning and ending at Pau, and a race called the Southwestern Circuit, over a route making a longer round, via Tarbes, Dax and Bayonne, a distance of 210 miles. Prizes will be awarded for the latter event to the amount of £320. A motor Gymkhana (so-called) obstacle race and battle of flowers, an exhibition of the competing vehicles, and a masked ball are also on the programme received of the fetes; but not the least, though the last, item was a meet of the Pau foxhounds, automobilists who have entered for the various races being expected to follow the hunt to the best of their ability on their motor cars.

A NEW INDUSTRIAL SITUATION.—In a pamphlet recently issued by the Westinghouse Companies some interesting propositions are presented for the consideration of the industrial world. In the introduction Mr. George Westinghouse states that his long familiarity with the electrical industry, the pipe-line transportation of natural gas in great quantities, and an active interest in the development of large gas engines led him to the conclusion that the economies which would result from the distribution of power by means of gas generated at central points and conveyed in pipes along the lines of railway, for the operation of engines and electric generators, will be sufficient to justify the expenditure of the capital necessary for such installations in connection with the electrical equipment of railways, particularly for metropolitan and suburban lines. Referring to the advantages of the gas engine, he points out that a gas company could supplant its present gas illumination by an equal amount of electric light obtained from gas-driven dynamos, and have over 60 per cent. of its present gas output left for sale for other purposes. Three conditions essential to the application of gas as a fuel for engine driving are pointed out—generation, distribution and use—and discussed with respect to the economies attainable by the use of the modern gas engines as demonstrated by figures obtained from tests of engines in actual use. Under the head of "Gas-driven Electric Machines for Railways," a general plan for a suburban or interurban power plant is outlined. Coal can be made into gas of a satisfactory quality at gas works suitably located. The gas can be taken by pipes to gas engines placed in the positions corresponding to the sites of the rotary converters, for a capital expenditure below that required for an equivalent steam boiler and engine plant. The cost for fuel per electrical horse-power so delivered should not exceed 50 per cent. of the cost of the fuel for generating electricity by steam for similar service. The pamphlet contains various illustrations of gas-engine electric plants, and altogether it forms very interesting and instructive reading.

THE MATHIESON ALKALI WORKS at Niagara Falls are to be enlarged in order that the bleaching powder department of the plant may be increased in its output facilities about 60 per cent.

INTERNATIONAL MARINE CONGRESS.—During the Paris Exposition this summer there will be held in that city an international marine congress for the purpose of considering matters of concern to all the great maritime interests of the world—shipbuilders and shipowners. Among the subjects to be considered in connection with technical matters in sailing are these: Improvements in signaling, lights and maneuvering; life-saving apparatus; wireless telegraphy, and buoys and lights on dangerous coasts.

LEGACY TO THE SOCIETE INTERNATIONALE DES ELECTRICIENS.—The late Prof. Hughes left a legacy of 50,000 francs to the French Société Internationale des Electriciens, of which he was a "membre fondateur" and a corresponding member for Great Britain. The French society, which was founded a year before the American Institute of Electrical Engineers, has received several legacies and also gifts of money on a number of occasions from members—its good fortune in these respects contrasting with the lack of similar encouragement to the American society.

"COPPER FROM THE ORE TO THE WIRE BAR."—The 203d meeting of the New York Electrical Society will be held at the College of the City of New York, Lexington Avenue and Twenty-third Street, at 8 p. m., Friday, March 2. Dr. A. R. Ledoux will lecture on "Copper from the Ore to the Wire Bar." He will describe the characteristic ores, exhibiting specimens, also the three types of mines from which copper is obtained in this country, those of Lake Superior, Arizona and Montana; giving an outline of the metallurgical process employed in each case, and exhibiting specimens of the product in different stages of refinement. Dr. Ledoux will also give valuable statistics of the growth of the industry and its present development.

AUTOMOBILES FOR ITALIAN FIELD ARTILLERY.—The Italian War Office has ordered the construction of a few automobile caissons for field artillery and will experiment with them next spring, and make the results public at the Paris Exposition. Three models for ordinary field service will be shown. One will be a strongly built vehicle of high power, provided with a motor which will produce a speed of forty miles an hour, intended for carrying despatches. The second will be a heavy-weight traction car for carrying large field pieces. One other will be a light petroleum motor tricycle armed with a Maxim gun. Motor ambulances, wagons for the use of the field telegraph service, and motors cars for the use of the general staff will also be exhibited.

THE AMERICAN STREET RAILWAY ASSOCIATION.—The nineteenth annual meeting of the American Street Railway Association will be held in Kansas City, Mo., Oct. 16, 17, 18 and 19, 1900. Papers will be read on the following subjects: "Double Truck Cars; how to equip them to obtain maximum efficiency under varying conditions;" "Construction, Operation and Maintenance of Roads that Operate 20 Cars or Less;" "Comparisons of the Various Systems of Electrical Distribution for Street Railways;" "Consolidation of Street Railways and its Effect upon the Public;" "The Storeroom and Storeroom Accounting;" "Painting, Repainting and Maintenance of Car Bodies." A building with 50,000 square feet of floor space has been secured for the display of exhibits. The annual banquet will be held on the evening of Oct. 19, when the officers-elect will be installed. The headquarters of the association will be at the Midland Hotel. It is expected that the usual railway rate concessions will be made, due notice of which will be given later.

CONSTANT-POTENTIAL OPEN-ARC LAMPS.—At the February meeting of the Société Internationale des Electriciens, the subject of open arc lamps in series on constant potential circuits was discussed. M. Bochet said that while he admitted that there was economy in using three open-arc lamps in series on 120-volt circuits, it is necessary to employ a superior grade of carbons and the photometric efficiency of a low voltage arc is less than that of one of high voltage. He referred to the case of a railroad using a large number of arc lamps three in series on 120-volt circuit with very satisfactory results. In this system it is necessary to have a margin between the total e. m. f. and the sum of the e. m. fs. at the binding posts of the lamps. M. Roux also referred to installations of arc lamps three in series on 115 to 120-volt circuit which give good satisfaction. M. Brillee said that he had been successful in working five lamps in series on a 220-volt circuit. With currents above 8 amperes it is not necessary to have special carbons, but for smaller currents high grade carbons must be used.

TROLLEY FITTING SUIT.—Bills in equity have been filed in the United States Circuit Court of the Southern District of New York by the General Electric Company and the Thomson-Houston Electric Company against the H. W. Johns Company, alleging infringement of a number of patents relating to line material for trolley roads. Similar suits involving other patents of the same general class have been instituted at Boston against of the Ohio Brass Company, the Bibber-White Company, the Macallen Company, and elsewhere against other makers of trolley line supplies. The patents sued on are said to cover most of the usual overhead appliances, such as the single and double curve pullover, straight-line suspension, cap and cone insulator, trolley-ear (both soldered and mechanical), trolley-wire crossing, trolley-breaker, turnbuckle, etc. F. P. Fish and T. J. Johnston appear for the General Electric Company; Wetmore and Jenner for the H. W. Johns Company. Mr. Johnston, after reading the above, said to the ELECTRICAL WORLD AND ENGINEER: "That is substantially correct. The suits are of the usual type, one side thinking its rights are violated, the other denying it. There is nothing to add, at least nothing in which the trade would be interested."

CARTY BRIDGING TELEPHONE PATENT.—Judge Acheson, of the United States Circuit Court for the Western District of Pennsylvania, has refused to grant an injunction to restrain the use of non-permanent ringer bridges in the multiple party line circuit, as covered by the well-known Carty patent. The court stated that the question of infringement in the case under consideration was altogether new, and as the solution depended upon the construction to be given to the Carty patent, and this involved a question of priority, he did not think that the court acting upon mere ex parte affidavits could undertake to decide the question in a suit for a preliminary injunction. Referring to a previous decision upholding the Carty patent (the Millheim case), the court said that certain circumstances connected with that decision ought to deprive it of effect. Those circumstances were that during the progress of the suit which led to the decision the American Bell Telephone Company bought up the property of the defendant and that consequently no real controversy existed when the case was heard in the Circuit Court. Judge Acheson added that he thought it might be affirmed confidently that if the learned judge who sat in the suit had known the facts, he would not have heard and decided the Millheim case, and that the Court of Appeals would have dismissed the appeal had the facts been brought to its notice.

DOUBLE-FLUID STEAM ENGINE.—In a recent consular report an account is given of experiments by Prof. Josse, head of the mechanical laboratory of the Royal Technical High School at Charlottenburg, Germany, with a means of increasing the efficiency of steam engines by utilizing the heat of the exhaust steam in evaporating another liquid having a lower boiling point than water. The second liquid employed is sulphurous acid. It is claimed that the efficiency of an engine to which the auxiliary apparatus was attached was very largely increased. It is also claimed that by this system a 2000-hp central station engine would furnish power to drive an additional 1000-hp engine. Much was expected of the two-fluid steam engine in the early days of steam power but, as pointed out by Rankine, the numerous experiments made with it demonstrated, as might have been predicated, that while by using a second liquid in connection with an uneconomical engine a superior combined efficiency may be obtained, little if any advantage would be derived in the case of an economically designed engine. This follows from the fact that the efficiency of a heat engine is a function of the heat supplied and that carried away in the condenser; and owing to the comparatively narrow temperature margin in the cooling water, the use of a second liquid condensing at a less temperature than that of steam will not compensate for the complications thereby introduced. It is somewhat astonishing that such a well-recognized fallacy as that involved in the two-liquid engine should be revived at a school of the standing of the one named.

NEW CABLE TO SOUTH AFRICA.—The Eastern Extension Telegraph Company, London, has announced that the third cable route between Europe and South Africa, via Ascension Island and St. Helena, was opened for business on Feb. 22. It is stated that with the opening of this route war despatches from South Africa should reach England two or three hours after they are filed.

ELECTRODEPOSITION OF METALS.—A patent was issued Feb. 20 to Sherard O. Cowper-Coles, of London, England, on a method of producing a polished surface in the electrodeposition of metals on a cylindrical cathode. The cylindrical cathode is vibrated in the electrolyte at a speed of 1000 feet per minute. By this means friction is obtained between the deposited metal and electrolyte, while hydrogen bubbles are thrown off the cathode, thus reducing the resistance and allowing of the use of a higher current density. The electrically-deposited metal by this means is rendered tough and smooth, thus reducing cost of burnishing.

ELECTRIC RAILWAY MOTOR CONTROL.—In a patent issued to J. J. Heilmann Feb. 20, a method is described for motor control when four motors are used on a car, or two double-armature motors. The object of the method is to so group the motors that in going around a curve skidding and injurious strains shall be avoided. The controller contacts are such that the four motors are arranged in series diagonally two by two; that is, one of the motors on the one side of the car is in series with one of the motors on the other side, but not in series with the motor on the same side. The same method can be applied to two motors if they have double-wound armatures.

THREE-PHASE ELECTRIC TRACTION.—A discussion on the report of the Committee of the English Institution of Electrical Engineers who visited Switzerland some time ago has proved very interesting, chiefly on account of the expression of opinion by members on the feasibility of three-phase currents for traction work as compared with the direct current in more general use. On some of the roads in Switzerland three-phase currents are used and three-phase motors are on the cars, the current being supplied to the motor in the usual way by means of trolley wire and trolley pole and the usual conducting wires, though somewhat more complicated. Though the three-phase system is used in some of the larger undertakings in England, the currents are transformed in substations by means of rotary transformers and direct current supplied from these substations to the cars themselves. In Switzerland, however, some cars are equipped with three-phase motors. Mr. S. Z. Ferranti's chief criticism on the three-phase transmission work in Switzerland, though favorable to the whole industry, related to complications in the apparatus connected with it especially in the switchboard and its connections. Mr. Ferranti also drew a pathetic picture of the difference between Switzerland and England as to the ease with which electrical projects can be carried through in Switzerland, as compared with the terrible difficulties that Englishmen have to contend with in England with vested interests, Parliamentary committees, and so forth. Mr. M. B. Field defended the system adopted by English roads, such as the Central London, the Dublin and the Middleborough where rotary converters are used, pointing out that in traction work, as in nearly all other applications of electricity, there were definite conditions to be taken into account. Some times, undoubtedly, it would be best to apply three-phase currents direct to the motor, whereas in other cases rotary converters and direct current became necessary. It depended, according to Mr. Field, largely on the area to be covered, and in a comparatively small area such as in most of the English cities, he maintained that the 500-volt direct current is the most economical. In mountain railways, however, such as were seen in Switzerland, it was quite possible that the three-phase working was the best, and Switzerland, he contended, was the proper home of the three-phase current, where it was possible to supply the trolley wires with two or three thousand volts and transform down with transformers on the car itself, and supply say 750 volts to the motors on the axles. Mr. A. E. Leven concurred with Mr. Field's statement of the case, and after a few details as to the cost of working, stated that it figured out as nearly as can be calculated about 1 cent per B. H. P.-hour. Mr. W. M. Mordey made some interesting remarks, also following in the same tenor as the other speakers, and appeared to think that English engineers could draw a good many general conclusions from their visit to Switzerland. He stated that English engineers would have to look to Switzerland rather than to America for guidance in their future workings, and stated that he felt that the Americans, while they had been the pioneers in the development of electrical engineering, had now got to such a stage that they were endeavoring to sell standard American material such as it was. He contended that under the influence of American engineers the English had been compelled to adopt American methods, though some of them were obsolete, because English manufacturers were not sufficiently prepared to meet the demands. He thought it was a pity that English manufacturers were following the American customs rather than by developing new apparatus such as Americans themselves would like to produce if they could start all over again. He therefore strongly urged English engineers to watch carefully the experiments in Switzerland, and he hoped that a great deal of the complicated machinery necessary with three-phase currents would be ultimately swept away.

LETTERS TO THE EDITORS.

Induction Motors for Electric Railways.

To the Editors of Electrical World and Engineer:

Sirs:—May I be permitted to make a few remarks on the much vexed question of polyphase motors for railway work commented upon in your editorial of Feb. 10?

The very fact that polyphase motors have not yet begun to be serious competitors of the direct-current motors in railway work might lead an unbiased observer to suspect that there must be some weighty reasons preventing their application to the street car service. In my opinion, the main objection to the polyphase motor in this field is the necessity of having to use two trolleys, and this great disadvantage is not sufficiently counterbalanced by other features. The speed question is not of very much importance; neither is the inductive drop caused by the lagging currents provided generator and motor are carefully designed. I should not consider the small air-gap an insuperable drawback; neither is the low frequency of 25, which would be advantageously used to get efficient motors, commercially impracticable. It is also possible to design a three-phase motor for this frequency so as not to be heavier than a direct-current motor yielding the same output.

Let it be granted, then, that the difficulties connected with the design of the motors, of the generators, and of the line could all be overcome, and that the cost of the installation did not exceed that of direct currents, the question may justly be asked, What would be the gain over a direct-current plant? I, for one, am inclined to think that there will be little, since, though we gain something by having simpler controllers and connections in the cars, and motors without commutators, we lose heavily by having to purchase this greater simplicity at the expense of a considerably more complicated overhead wiring system. The above considerations will be found to account for the fact that the polyphase motor has not yet seriously encroached upon the domain of the direct-current motor in the sphere of electric traction.

As was very ably pointed out in your editorial, the case of mountain railroads in Europe is very different from the one here under consideration.

B. A. BEHREND.

ERIE, PA.

Parallel Operation of Direct Coupled Alternators.

To the Editors of Electrical World and Engineer:

Sirs:—I have read a letter by Mr. Joseph Wetzler in the ELECTRICAL WORLD AND ENGINEER of Jan. 27, which refers to my article on parallel operation of direct-coupled alternators.

Mr. Wetzler quotes from a paper by Mr. R. D. Mershon on this subject, and his letter implies that Mr. Mershon's statements in some degree describe the principle which is explained in my article. This, however, is not the case. The paragraphs quoted clearly express certain truths concerning the relations of the engine and the alternator during parallel operation. They do not, however, touch at all upon the oscillations of relative motion which have constituted the most serious difficulty in parallel operation, and do not refer to any means of overcoming these oscillations by special governor adjust-

ments or otherwise. My article related simply to this question of oscillations and does not touch upon other features of the problem.

Schenectady, N. Y. W. L. R. Emmet.

A Curious Switchboard Phenomenon.

To the Editors of Electrical World and Engineer:

Sirs:—Referring to the interesting question regarding the rapid collection of dust on certain terminals of the switchboard of the Postal Telegraph Company, as described in your issue of Feb. 17, it seems that perhaps the following explanation might be the answer:

The cause is due to static discharges into the air between the discolored buttons of the same voltage, it being well known that a static discharge will collect dust at the point of discharge.

From an intimate knowledge of the construction of these machines gained while designing many of the machines manufactured for this company, I am led to believe that the seat of this static electricity will be found in irregularities of the armature winding. These irregularities arise from the fact that each armature slot contains four different coils, two of the primary and two of the secondary. There being but one pair of field magnets, knowledge of mutual induction will point out that the commutation of one coil will affect the other in the same or adjacent slots. This will superimpose a voltage of varying intensity and very high frequency on the potential of the machine. I presume that in the 85 and 200-volt machines this is of sufficient magnitude to cause the static discharges alluded to. In the case of the other machines the winding is more symmetrical, or perhaps the machines have double fields.

A very simple way to test this theory would be with an electrometer; the 85 and 200-volt buttons should show greatest deflection. Should such an instrument not be available, the trial might be made of changing the 85 or 200-volt leads to other buttons, which should then collect dust more rapidly, if the explanation presented is correct.

New York, N. Y. J. J. Bellman.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

Dynamos, Motors and Transformers.

Friction Losses in Dynamos.—Hawkins.—A communication referring to the article of Hay (Digest, Feb. 17). He agrees with Esson, Fisher-Hinnen and Bailey, that any increase of pressure due to want of symmetry in the magnetic field of a dynamo usually increases its bearing friction. The increased pressure is applied to the shaft midway between two bearings. The shaft therefore must be more or less bent and this affects the exact condition of the journals relatively to the bearing surfaces. The whole question, as to how far the increased load will increase the friction, turns entirely on the rigidity of the shaft, and Dettmar's experiment with an eight-pole generator (Digest, Oct. 7) probably only shows that the shaft and core were very rigid, so that although the armature was pulled upwards or downwards by the unequally excited poles, the bending of the shaft was inappreciable. The heating of the bearings in an excited dynamo which runs cool when not excited, may be due to bad workmanship or defective lubrication, or to bad design, such as the use of a shaft which is not sufficiently stiff, or if the want of symmetry in the field is due to some abnormal condition, the shaft may be subjected to a stress for which it was not designed.—Lond. *Elec. Rev.*, Feb. 9.

Starting Device for Synchronous Phase Transformers.—An illustrated description of a method used by Schuckert & Co. Three-phase induction motors are connected between the two single-phase supply mains and a third supplementary main receiving current from the phase transformer, which is an ordinary synchronous converter, running as a synchronous motor when supplied with single-phase current and developing the phase-displaced currents required by the motors. The starting device consists in producing a phase displacement by means of a choking coil so as to obtain a rotating field in the armature; the field coils being short circuited, the transformer starts. As it cannot be brought up to synchronous speed by this method, a device for temporarily halving the number of field poles is provided. The transformer is run up to a speed above synchronism, the current switched off, the normal field connections are restored, the current is switched on at synchronism and the field excited. In order to prevent sparking, when the transformer is self-exciting, a "steadying" secondary battery is used. The latter provides a second method of starting, the transformer being brought up to synchronism as a simple continuous current motor.—*Elek. Rund.*, July 1; abstracted in *Science Abstracts*, January.

Lights and Lighting.

Nernst Light.—A note stating that the Nernst lamps will very soon be introduced commercially in Goettingen by the General Electric Co., of Berlin, which is erecting the central station in that city. For each Nernst lamp installed, besides the price of current, a rent of 13 cents per month will be charged. An alcohol apparatus for lighting the lamp, will be furnished gratis. Nernst lamps with automatic lighting will not yet be brought into commercial use. An illuminating power of 24 Hefner candles is guaranteed with a current of about that of a 10-c incandescent lamp.—*Elek. Anz.*, Feb. 8.

Incandescent Filament.—Scharf.—A short description of a method devised by him for obviating the use of a separate heating device for Nernst and similar electrolytic lights. He provides the filament with a core, which already conducts the current at normal temperature and which is formed of a mixture of metallic and electrolytic conductors of poor conductivity. The Joule effect heats the surrounding electrolytic material. It is of advantage to do that at a higher voltage than the normal, which is accomplished by a special device, by which first a higher and afterwards the normal voltage is used.—*Zeit. fuer Beleucht*, Jan. 30.

Electric and Gas Lamps.—Rumi.—A comparison of the electric incandescent lamp with the Auer incandescent gas lamp. In point of economy in illumination the latter is superior, but the life of a gas mantle is considerably less than that of an incandescent lamp. The average percentage loss of candle-power of two English and three German mantles, after burning 100 and 500 hours, is 15 and 45 per cent. respectively. Voelher found a loss of 50 per cent. in the light of two English mantles after 250 hours. For the loss of light in electric lamps he gives 20 per cent. after 500 hours as a practical figure, taking perfect and faulty lamps together.—*Rivista Sci. Industriale*, June 30, 1899; abstracted in *Science Abstracts*, January.

REFERENCES.

Incandescent Light.—An illustrated article, giving some historical data on the discovery of incandescent electric lighting and claiming that it was originally made in Toronto by Woodward and Evans.—*Can. Elec. News*, February.

Public Lighting.—An article giving a simple mathematical method of determining the proper arrangement of arc lamps for public lighting, with respect to light distribution.—*Elek. Anz.*, Jan. 21.

Power.

Gas and Steam Engines for Electric Plants.—Harding.—A short illustrated description of the electric lighting plant of a department store in Detroit. The original plant contains a complete boiler plant and coal bin with a steam engine direct connected to a direct current generator. In the recently built annex a 50-hp gas engine is direct connected by spring coupling to a 32.5-kw generator. This addition duplicates the lighting circuits, but less than 200 square feet of floor space is occupied by it as against 1350 square feet of the original half. Natural gas is used for fuel for the engine, costing 28 cents per 1000 cubic feet. The gas bill for 26 days, running 10 hours per day with full load was $27. It is stated that it cost less to operate the gas engine for a whole day than the value of the fuel required to start up the steam boiler. There are gas engines in operation which can transform over 25 per cent. of the heat in the fuel into useful work, while in the best performance of steam engines barely 14 per cent. of the energy in the coal is "accounted for."—*Prog. Age*, Feb. 15.

REFERENCES.

Power Transmission Plant.—Doble.—A very long well illustrated description of the electric power transmission in the San Joaquin

Valley, Cal., referred to in the Digest Jan. 6.—*Jour. of El'ty*, January.

Triest.—SZUK.—An illustrated description of the power plant of Triest. For the tramway continuous current at 550 volts is used; for the distribution for light and power purposes three-phase current at 2000 volts.—*Elek. Zeit.*, Feb. 1.

Protection of Electric Power Transmissions Against Lightning.—MORRIS.—A continuation of his illustrated paper (Digest, Feb. 10), giving a table of non-arcing metals and describing the Wurts non-arcing metal lightning arrester and the Oerlikon zinc rod lightning arrester.—Lond. *Elec. Rev.*, Feb. 2.

Electricity on Warships.—A well illustrated description of the Schneider-Canet electrically operated turrets now in regular service on board a large number of modern warships. A closed turret for one 4.724-inch gun and a closed-in turret for two 4.724-inch 45 calibre quick-firing guns are described in detail.—Lond. *Eng'ing*; reprinted in *Sc. Amer. Sup.*, Feb. 17.

TRACTION.

Electric Traverser for Railway Carriages.—SABOURET.—An illustrated description of a traverser used in the Orleans Railway station at Paris to carry railway carriages from one line across to the adjoining rails. The rails on which the traverser runs are practically level with the ordinary running rails, a system of duplicate bearing axles being used to get over the difficulty of the gaps left in these rails where the ordinary running rails are crossed. There are two trucks, one taking the railway carriage, the other provided with the electrical arrangements for moving it and fitted with a hauling arrangement. Three trolley wires are used to take the current to the motor, "because in this railway station electricity is distributed on the continuous current system at 375 volts with 125 volts between each pair of wires. Two of the trolley wires supply the armature at 375 volts. The remaining wire is used for excitation purposes, there being 125 volts between it and one of the first pair." The traverser transports 250 to 350 vehicles during 24 hours.—Lond. *Elec. Eng.*, Feb. 9.

Electric Automobiles.—HANCHETT.—Some general precise rules for laymen showing how to charge batteries. He also calls attention to the fact that corroded contacts are a frequent source of trouble; the remedy is to clean the contacts thoroughly and paint them with vaseline. The evil effects of the fumes due to charging should be avoided as much as possible by ventilation. Those contacts between the cells which are never to be broken, should be burned together. Great care should be taken to keep spilled electrolyte from the woodwork of the crates. Electric lighting of an automobile requires only a very small part of the available power. Calculations to find the capacity of a battery necessary to propel a vehicle a given distance may be based on 120 watt-hours per ton mile. As an average of the relation between the capacity and weight of an accumulator he gives 6 watt-hours per pound.—*The Automobile*, February.

Electric Automobiles.—An editorial referring to the recent paper of Kallman (Digest, Dec. 9) and to the failure of the London electromobile companies, which do not seem to show good prospects for the use of accumulators for automobiles. As proof of the contrary, the article by Maxim (ELEC. WORLD AND ENG., Dec. 23) is abstracted. "We do not know whether similar or better results have been obtained by German firms, but we think it possible. At all events, it is to be desired that the German automobile industries publish their results in the same objective and scientific way as the American."—*Elek. Zeit.*, Feb. 1.

REFERENCES.

Saratoga.—An illustrated description of the trolley lines from Saratoga to Ballston Spa, and between Saratoga Springs and Saratoga Lake, the length being 14 miles of single track.—*St. R'y Rev.*, Feb. 15.

Coventry.—An illustrated description of the new generating station for the Coventry electric tramways. There are four 100-kw dynamos giving current at 500 volts.—Lond. *Elec. Rev.*, Feb. 2.

Maintenance of Cars.—An article of a very general nature, discussing some conditions affecting the maintenance of cars and their equipments.—Lond. *Elec. Rev.*, Feb. 2.

Snow Plow.—A well illustrated description of a snow plow for street railways, equipped with four electric motors. The total weight is 23 tons: the body 4 tons, noses 2 tons, trucks and motors 14 tons, 10 barrels of salt and sand 3 tons.—*St. R'y Rev.*, Feb. 15.

Charging Automobile Accumulators from Alternating Circuits.—WEAVER.—An illustrated article on the use of motor generators for this purpose. The plan of a charging plant of the Illinois Electric Vehicle Transportation Co., in Chicago, with two motor generators, is given in a diagram.—*The Automobile*, February.

Accumulators.—BAINVILLE.—A long ilustrated description in detail of the eight accumulators which were discharged more than 60 times in the recent Paris competition (Digest, Feb. 10).—*L'Ind. Elec.*, Jan. 25. There are other descriptions by Bainville of the accumulators which participated in the tests, including some not among these eight, begun in *L'Eclairage Elec.*, Jan. 27, Feb. 3, and *L'Elec.*, Jan. 27, Feb. 3, 10.

Electric Canal Boat Haulage.—An illustrated article on the German trials of the Lamb and Koettgen systems, noticed in the Digest July 22, Sept. 2.—*West. Elec.*, Feb. 17.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electric Standardization.—SELLON.—A paper read before the Brit. Inst. of Elec. Eng. on the standardization of electrical engineering plants. Standardization means the interchangeability of parts, for the producer, and less capital outlay for the consumer, prompt delivery, immunity from the risks attendant on novel designs, full manufacturers' guarantees. The successful competition of American and continental firms with the British is said to be due to the lack of standardization in England. According to British custom the buyer generally imposes upon the manufacturer, not merely a specification of the ends he wishes to attain, but the details of the means by which he desires those ends to be achieved. Standardization is primarily the function of the producer and not of the user or his engineer, because the former is in a better position to determine experimentally the direction and extent to which it is possible. He says that a mutual advantage to producer and buyer will only result if standardization be confined to ends or performance, and not to means or constructional detail; under ends or performance would fall the following: steam pressure, electrical pressure of generation, electrical pressure of distribution, periodicity of alternating current generation, sizes of generating steam units in convenient fractions or multiples of horse-power, kilowatt, sizes of mains, sizes of motors, similarly as regards transformers or arc and incandescent lamps, essential fittings and accessories. He proposes the determination of standards by organized effort, to be undertaken under the auspices of the British Inst. of Elec. Eng., as representing the interests of both producer and user.—Lond. *Elec., Ind. and Iron*, Feb. 9; the first part also in Lond. *Elec. Eng.*, Feb. 9.

Incandescent Lamp and Transformer Construction in America.—COTTRELL.—An article pointing out that the average specific efficiency, and not the length of life, should receive the chief consideration in selecting a lamp. The effective illumination or "candleage" of a lamp is to be determined while rapidly revolving and its rating is to be made to correspond accurately with the actual average illumination of the whole horizontal plane and not with one or more selected points in that plane. The factors which determine the candleage are discussed. The second part of his article deals with transformer construction. He advocates that the insulation between the primary and secondary of the transformer should be subjected to a disruptive test in the factory, of at least 10,000 volts, the transformer itself being subjected momentarily to double, treble or even quadruple the working pressure. The only way to avoid the ageing of the iron by increase of the hysteresis losses, is to ensure uniformity of texture in the cores by building them up of thin discs of carefully selected metal, these discs being insulated by japanning and joined by strips, three, four or five in number, along the edges. The width of the gap between the discs has no effect upon the efficiency of the cores made from them. The discs are pressed together as close as possible, so that the gaps composed of japanning are reduced to a minimum thickness. The principles of the use of transformers in central stations are discussed.—Lond. *Engineer*, Oct. 13, 20; abstracted in *Science Abstracts*, January.

Electric Installation of the Paris Exposition.—A reprint of the official regulations concerning the generation and distribution of energy. The following systems will be used: the three-wire continuous current system at 2×220 volts; the two-wire continuous current system of 500 volts; the single-phase alternating current system partly at 2000 volts primary and 110 volts secondary, the frequency being 50, partly at 3000 volts primary, 110 volts secondary with a frequency of 42; the three-phase alternating current system, partly at 2000 volts primary, 110 volts secondary, with frequencies of 50 and 42, partly at 4800 volts primary and 110 volts secondary with a frequency of 50. The energy used for driving exhibited apparatus is furnished by the administration free of charge. The public electric

lighting of the Exposition is divided into eight districts. There will be 1300 continuous current arc lamps, 60 single-phase alternating current arc lamps, and 1500 arcs supplied by three-phase current, the total being 2860 arcs; also 18,000 incandescent lamps, 14,000 being supplied by continuous current and 4000 by three-phase current. The whole number of electric lamps is therefore 21,000 for the general service alone. Including the installations of the exhibitors, the restaurants, etc., the number of electric lamps in the Exposition will be more than 50,000.—*L'Ind. Elec.*, Jan. 25.

REFERENCES.

Solutions Containing a Chloride and a Sulphate With a Common Cation.—Barnes.—An account of an experimental investigation showing that by the aid of the dissociation theory and with data obtained from the simple solutions, it is possible to predict the electric conductivity, specific gravity and surface tension of fairly dilute solutions of potassium chloride and potassium sulphate, within the limits of experimental error.—*Transact. N. S. Inst. of Sc.*, Vol. 10.

Charges for Lighting.—A table giving a summary of the electric light receipts at Belfast for the year 1899 and showing the increase of energy sold, due to the adoption of the maximum demand indicator system.—Lond. *Elec. Eng.*, Feb. 2.

Electrical Fittings.—Illustrations, with short descriptions, of some electric fittings, made by a British company.—Lond. *Elec. Rev.*, Feb. 2.

Wires, Wiring and Conduits.

Fusing Currents for Copper and Tin Wire.—J. C. B.—A note giving the results of measurements of the fusing currents for copper and tinfoil in air and in oil. Four pieces were prepared of the same length and the same radiating surfaces. The current was passed through 6 in. of their length in air and a viscous oil of insulating property, and the "relative" currents were for copper in air 26.4 amp., for tin in air 6.1 amp., for copper in oil 66 amp., for tin in oil 17 amp. The time was the same for all, namely, 25 seconds; the cross-section is not stated. The ratio of the current carrying capacity of copper to that of tin is therefore in air as 4.33 to 1 and in oil 3.88 to 1.—*Elec. Eng.*, Feb. 9.

REFERENCES.

Calculation of Sizes of Distributing Mains.—Hecker.—A paper considering the case of a distributor, simple or branched, and fed from one end only, the total fall of potential along it being given. The cross-section of the various parts of the distributor are varied until the total amount of copper required for the distributor becomes a minimum, and formulas are deduced for the drop of potential along each section of the distributor when the two conditions of given total drop and minimum total copper are satisfied.—*Deutsche. Zeit. Elek.*, Oct. 15, Nov. 1; briefly abstracted in *Science Abstracts*, January.

Electro-Physics and Magnetism.

Discharges Through Gases.—Strutt.—An abstract of a Royal Society paper on the potential difference required to produce sparks in various gases between large parallel planes at a fixed distance apart, and at various atmospheric pressures. The striking potential between two plates diminishes as the pressure diminishes, till a certain point is reached, and then begins to rise very rapidly. The minimum potential is nearly independent of the distance between the plates. This fact is explained as follows: The negative glow in any gas requires for its production a definite difference of potential independent of the atmospheric "pressure and constant," so long as the glow is not crushed into a smaller space than that which it would naturally occupy. The minimum striking potential occurs when the pressure is low enough to make the negative glow occupy the whole space between the plates, but not low enough to make it require more. Experiments made by him are in favor of this explanation.—Lond. *Elec.*, Feb. 2.

Dielectric Constants in Solid and Liquid State.—Abegg and Seitz.—Two papers. In the first they state that Abegg's formula was found to agree well with the measurements for the liquid alcohols at temperatures as low as -140°, and for nitrobenzine down to -9°. On solidification the dielectric constant drops suddenly and enormously. The increase of viscosity of the alcohols to a glassy solid, which is to the eye a continuous change, is shown by the dielectric constant to be a sharp change of state. The visible change from a glass to a crystalline solid, takes place without change of the dielectric constant. The second paper gives an account of experiments made to observe the changes which take place in the value of the dielectric constant of a crystalline solid as it gradually cools in the liquid state and then slowly crystallizes. The solid experimented upon was p-Azoxyanisol. At 95°, when the crystallization begins, the dielectric constant falls rapidly from 4.3 as the liquid crystallizes, until when all is solid at about 80° the constant is 2.3.—*Zeit. fuer Phys. Chem.*; abstracted in *Science Abstracts*, January.

Pressure Within the Spark.—Mohler.—A description of experiments made to test the results obtained by Haschek and Mache (Digest, Sept. 30). He found that there is pressure produced when the spark passes through a medium, but that it is not nearly so great as was supposed from the researches of Haschek and Mache. The results also show that the amount of pressure varies with the density of the medium surrounding the electrodes, and that the kind of gas does not affect the result.—*Astro-Phys. Jour.*, October; abstrated in *Science Abstracts*, January.

REFERENCES.

Cyclic Electrical Processes.—Doerge.—An application of thermodynamic methods to electric theories. He describes a process analogous to that of Carnot and obtains a counterpart of the second law of theromdynamics in the proposition that "no process is possible consisting only of the transfer of electrical energy from a higher to a lower potential without the absorption or the giving out of work." He tried to prove his conclusions experimentally, but with only partial success.—*Ann. der Physik.*, January; abstracted in Lond. *Elec.*, Feb. 2.

Electromagnetic Theory of Light.—McAulay.—Two mathematical notes; one on the geometrical properties of the wave-surface, the other on reflection and refraction at the surface of crystals, treated by a theorem of Hamilton.—*Phil. Mag.*, February.

The Function of the Condenser in an Induction Coil.—Johnson.—A short article giving a theoretical explanation of the results of Mizuno's researches on the relation between the capacity of a condenser, the intensity of the primary current, and the secondary spark length. His theory is in agreement with Mizuno's measurements.—*Phil. Mag.*, February.

Conductivity of Metals.—Jaeger and Diesselhorst.—An account of measurements, made in the German Reichsanstalt, of the ratio of the electrical to the thermal conductivity, by Kohlrausch's method (Digest, Dec. 30), for pure Zn, Sn, Pb, Cu, Cd, Bi, Ni, Al, Ag, Fe, Pt, Pd, An, steel, cast iron and constantan. The heat capacity and thermoelectric powers were also obtained from the experiments.—*Sitzber Preuss. Akad. Wiss.*, 38, p. 719; abstracted in *Science Abstracts*, January.

Conductivity of Mixtures.—Lees.—The Brit. Phys. Soc. paper in full, an abstract of which was noticed in the Digest Dec. 23.—*Phil. Mag.*, February.

Electric Waves.—Barton and Lownds.—An abstract of a Brit. Phys. Soc. paper on an experimental investigation of the reflection and transmission of electric waves along wires. The results were found to be in close agreement with the theory of Heaviside.—Lond. *Elec., Elec. Eng., Ind. and Iron*, Feb. 2.

Röntgen and Becquerel Rays.—Walter.—An account of experiments showing that there are considerable differences in the absorption and diffusion of these two types of rays. The strong diffusion of Becquerel rays by air and by bodies of small atomic weight, renders them unfit for surgical use.—*Fortschritte d. Röntgenstrahlen*, III; abstracted in Lond. *Elec.*, Feb. 2.

French Academy of Science.—A reprint of that part of the address of the president, Van Tieghem, which relates to recent progress in physics and engineering. The La Caze prize was given to Prof. Blondlot, the Wilde prize to Dr. Zeeman, the Planté prize to Mr. Leblanc.—*L'Ind. Elec.*, Jan. 10.

Tractive Power of an Electromagnet.—Boy de la Tour.—An illustrated mathematical article in which he develops the well-known formula for the tractive power of an electromaget by means of an interesting method, analogous to those used in thermodynamics, by considering a certain cyclic process and applying the law of the conservation of energy.—*L'Ind. Elec.*, Jan. 10.

Magnetic Elements.—Morcaux.—A note presented to the Paris Academy of Science on the absolute value of the magnetic elements at the first of January, based upon measurements made in three French observatories provided with identical apparatus.—*L'Ind. Elec.*, Jan. 25; abstracted in Lond. *Elec. Eng.*, Feb. 2.

Electro-Chemistry and Batteries.

Electrolytic Production of Copper Tubes.—Cowper-Coles.—An illustrated paper read before the Brit. Inst. of Elec. Eng. After an

outline of the recent development of electrical refining of copper, he describes an electrolytic centrifugal process which is now being worked on a practical scale, for copper refining and the manufacture of copper tube, sheet and wire by electrodeposition, which does away with the troubles of lamination and enables a much higher current density to be used than has hitherto been the case, smooth tubes having been produced 12 inches in diameter at the remarkably high current density of 190 amp. per square foot, the voltage being from 1 to 1.2. There are no burnishing tools used, but the cathode on which the copper is deposited is revolved at a high rate of speed, the result being that the skin friction, between the deposited metal and the electrolyte keeps the copper beautifully smooth and compact. Any gas bubbles evolved at the cathode, or impurities in mechanical suspension in the electrolyte which would have a tendency to settle on the cathode, are thrown off by centrifugal force. The apparatus used in the process is described and illustrated. The electrolyte is briskly circulated through the cells by means of an acid proof pump or air pump. The process enables a hot and more acid solution to be used than is generally employed. The amount of free acid has a very marked effect upon the voltage required, but a very small effect upon the actual weight of copper obtained, compared with the theoretical, which is shown in a table. Another table gives the voltage required when depositing at 100 amp. per square foot for various percentages of free acid. A third table gives the variation of current and voltage due to the temperature of the electrolyte. A hot solution allows a larger current to pass at a much lower voltage, 150° F. being probably the most economical temperature. The possibility of using high current densities has the incidental advantage of reducing the quantity of anode sludge, thus making the working up of silver or gold easier and more economical. Copper prepared by electrolysis may have as low a density as 8.00, the figure for normal copper is 8.9. Hard rolling, cold hammering, and hard drawing increase the tensile strength and the limit of elasticity of copper considerably. Some copper sheet, not annealed, deposited by the centrifugal process, 0.0245 in thickness, broke at 433 lbs., which is equal to 22.1 tons per square inch. Hard-drawn wire made by this process has a tensile strength of 29 tons per square inch, annealed 20 tons, the electrical conductivity being 99 per cent. He has obtained excellent tough deposits of copper with the theoretical yield from a solution composed of copper sulphate, including 5 molecules of water, 32 oz. per gallon, or 14.87 per cent. per weight, sulphuric acid 12.6 oz. per gallon, or 10.77 per cent. per weight, water 74.36 per cent. per weight (the parallel sets of figures do not seem to agree). The effect upon the electric conductivity, of annealing at different temperatures, is shown in a table. Finally he gives figures for the approximate cost of producing electrical energy on a large scale with condensing engines, the cost per kw-hour working out to .3995 pence, in which case the cost of electrical energy required to deposit one ton of copper is $3.60.—Lond. *Elec., Elec. Eng., Elec. Rev.,* Feb. 9; abstracted in *Lightning,* Feb. 1.

Electrolytic Evolution of Gases.—CASPARI.—An account of an experimental investigation a preliminary record of which, given by Coehn, was noticed in the Digest Aug. 26. The investigation was made to determine the minimum e. m. f. at which gas bubbles are evolved in the electrolysis of acid solutions. With platinized platinum electrodes in acid solution a visible evolution of gas begins first of all with 1.55 to 1.56 volts at ordinary temperatures and pressures. The evolution of hydrogen on platinized platinum is practically a reversible phenomenon, and the theoretical e. m. fs. are obtained. Other metals require an excess e. m. f. This excess e. m. f. is increased by great current density, but is little influenced by the nature of the surface of the electrodes. The excess e. m. f. is the deciding factor in the chemical evolution of hydrogen from the interaction of metal and acid, making the evolution possible with some metals and not with others. The deposition of bromine and of iodine on platinum fulfils the conditions of reversibility. Silver is deposited from complex salts, also as a reversible phenomenon in spite of very low ion concentration.—*Zeit. fuer Phys. Chem.,* 30, p. 89; abstracted in *Science Abstracts,* January.

Electrolysis of Sulphate of Potash.—GROSS.—A very brief preliminary note stating that he has electrolyzed molten sulphate of potash with platinum electrodes. The heat necessary for the melting of the salt is furnished by the current itself. The cathode is consumed by combining with the cation. From the material thus obtained a substance called by him 'bythium" can be precipitated.—*Elektrochem. Zeit.,* Feb. 1.

Complex Solutions.—MACGREGOR.—A paper describing a new method of determining the state of ionization of a complex solution, when the concentration is given; and conversely, to determine the concentration which must be given a complex solution in order that it may have any required state of ionization. It is a modification of a method, formerly used by him, but in the application it requires fewer data with respect to the conductivity of simple solutions of the electrolytes involved and is subject to fewer sources of error than in its old form. He also compares his method with those used recently by Schrader and Kay.—*Transact. N. S. Inst. of Sc.,* Vol. 10.

Conductivity of Solutions.—KOHLRAUSCH and MALTBY.—An account of very careful measurements of the conductivity of aqueous solutions of alkaline chlorides and nitrates. Up to and including the concentration 0.002 gram molecules per liter, the law of independently mobile ions is exactly true; in more concentrated solutions this is not the case. The diminution of the equivalent conductivity with increasing concentration is roughly proportional to the square root of equivalent conductivity.—*Sitzber. Preuss. Akad. Wiss.,* 36, p. 665; abstracted in *Science Abstracts,* January.

The Real Surface of Accumulator Plates.—NORDEN.—An article calling attention to the importance of the ratio of the real surface of an accumulator plate to its apparent surface which is the product of length and breadth. This ratio should be made as great as possible. For regularly formed surfaces the real surface can be easily measured; in this way Wilke found that ratio to be 8 to 9 for the Tudor type and 14 for the Majert type. For plates of irregular surfaces or for porous plates the real surface cannot thus be measured. He describes an interesting exact method which can be used in such cases and which is based upon the following considerations: Any primary electrochemical effect is, according to Faraday's law, dependent upon the current. A part of the primary products of the work of the current may, however, form a secondary combination either with the electrodes or with the electrolyte, the effect depending upon the current density, i. e., the current per unit of real surface, not apparent surface. If the relation between current density and secondary effect is known, the measurement of the secondary effect can be used to find the current density and therefrom the real surface. For practical application such a secondary effect may be used to advantage, in which the quantitative and not the qualitative properties of the reaction vary with the current density, and in such a way that for decreasing current density that part of the whole effect, which appears as secondary effect, increases, as in the electrolysis of oxalic acid or acetic acid and their salts, when gases are developed at the anode, the quantities being dependent upon the current density. He describes a series of experiments with oxalic acid which prove the correctness of the method, and promises an article on its practical application to the measurement of the real surface of accumulator plates.—*Zeit. fuer Elektrochemie,* Feb. 1.

Jeanty Primary Battery.—A description of this battery, which is of the Daniell type, with special arrangements for maintaining a constant supply of sulphate of copper. On a trial of 34 days continuous use it consumed 14½ lbs. of commercial sulphate of copper and 3 lbs. of impure zinc per kw-hour, costing 29 cents. It is used experimentally to operate a system of electric signals of a French railway and for lighting a Paris excursion steamer.—*Elettricita,* July 1; abstracted in *Science Abstracts,* January.

REFERENCE.

Voltaic Cell.—A full translation of the appendix to Prof. Righi's Como Congress paper, comparing the contact and the chemical theories of galvanism, and also an outline of the theory of the voltaic cell, based upon the theory of dissociation.—Lond. *Elec. Rev.,* Feb. 9.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring the Temperature Heat of the Electric Furnace.—RAND.—In an article on an electric furnace he describes the following method which is said to be used to measure the temperature. A thin film of platinum is heated red hot, 1800° F., by a certain current of electricity. A delicate thermometer is placed 3 ft. off and a reading is taken; the filament is then made white hot, 3400° F., by a stronger current and the thermometer moved away until it reads the same as before; this then gives a basis for measuring the temperature of the furnace, the thermometer being exposed to radiations from the furnace and moved to or from it until the reading is again the same, the temperature being assumed to be approximately proportional to the distance. It was thus found that aluminum becomes a limpid liquid at 4050° to 4320° F., that lime melts at 4940° to 5400° and magnesia at 4680° F.—*McClure's Mag.*; abstracted briefly in *West. Elec.,* Feb. 27.

REFERENCE.

Addenbrooke Electrometer.—An illustrated description of the "electrostatic ammeter" referred to in the Digest Feb. 17 under "Alternating Current Instruments."—Lond. *Elec. Eng.*, Feb. 2.

MISCELLANEOUS.

Hopkinson Memorial.—A description of the proceedings at the opening of the John Hopkinson memorial wing of the engineering school of the University of Cambridge. It has been erected by Hopkinson's widow and children. Lord Kelvin gave the memorial address.—Lond. *Elec., Elec. Rev.*, Feb. 9.

New Books.

CENTRAL STATION ELECTRICITY SUPPLY. By Albert Gay and C. H. Yeaman. New York: The Macmillan Company. 470 pages, 200 illustrations. Price, $3.00.

Prefaced by a brief review of the history of electricity supply in Great Britain, this work describes in detail the different apparatus connected with the central station supply of electricity. The selection of a system is first considered and the advantages and disadvantages of the different systems are pointed out. The location of the station, the construction of the building, the different classes of apparatus to be used, etc., are each discussed in detail.

The methods of charging for current that were first adopted and abandoned, and the methods in use at the present time are fully described. The importance of adopting a rate that will help to fill up the load curve and at the same time be simple and just is emphasized. In commenting on the two-rate system, the authors describe an interesting but impracticable system brought out in Norwich several years ago. Integrating watt-hour meters were to be installed, the shunt coils of which were to be connected to a special meter wire run all over the district so that by interposing resistance in this circuit during certain specified hours, the meters would run slow, therefore being equivalent to a cheap rate. Whether this method was actually put into operation or not is not stated, but the objections to such a system are clearly brought out. These sections of the book serve to show the great amount of study that has been given to the rate question.

The two, three and five-wire direct systems of supply with the different methods of balancing used in the three and five-wire systems are ably discussed, the reliability and economy of each being considered from an engineering and commercial standpoint, and the same is true with respect to the discussion of the generation of high pressures for transmission to substations, there to be converted into low tension direct or low tension alternating current.

Transformer substations, both underground and overground, with descriptions of the substations, transformers, controlling apparatus, etc., are described in detail. The authors state that in London these substations may be built below the footway or roadway of streets, and for this privilege no rent is paid. This seems to be quite an important financial consideration, resulting in lower fixed charges.

The book ends with a brief description of the running and management of a central station and a table giving the average cost of generating current in a number of London and provincial stations for the years 1896 and 1898. Though relating solely to British practice, the work contains much that will interest the American central station engineer. One of the merits of the book is that the authors are careful not to commit themselves with respect to apparatus and methods of which they have had no personal knowledge.

Directory of Electrical Societies, Etc.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 26, 27 and 28, 1900.

NEW YORK ELECTRICAL SOCIETY. Next meeting March 2, at the College of the City of New York, Twenty-third street and Lexington avenue, 8 p. m. Lecture: "Copper from the Ore to the Wire Bar," by A. R. Ledoux.

CHICAGO ELECTRICAL ASSOCIATION. Next meeting, March 2. Paper: "Recent Progress in the Field of Electrochemistry," by H. R. Kingman.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, New York. Next meeting, Feb. 28. Paper: "Notes on Electric Traction Under Steam Railway Conditions," by Edward C. Boynton.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Ottawa, Ont., June 27, 28 and 29.

SOUTHERN INDEPENDENT TELEPHONE ASSOCIATION. Next meeting, Memphis, Tenn., Feb. 28, 1900.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Kansas City, Mo., Oct. 16, 17, 18 and 19, 1900. For list of papers, see Current News and Notes.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Chicago, May 22, 23 and 24, 1900.

NATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Pittsburg, Pa., Sept. 25, 26 and 27, 1900.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Next meeting, New York, Sept. 25, 26 and 27, 1900.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Next meeting, Detroit, Mich., June 20, 1900.

Large Induction Motors for Paris.

The induction motors shown in the accompanying illustrations have recently been shipped by the Westinghouse Electric & Manufacturing Company to Paris. They are rated 850-hp each, and are said to be the largest induction motors yet made.

At the Paris Exposition it is proposed to provide for the convenience of sightseers two movable sidewalks, the details of which were described some months ago in these columns. One of them is a slow-speed platform, traveling at the rate of two and three-fourths miles per hour, and a high-speed platform with a speed of five and one-half miles per hour. The weight of the slow-speed platform when empty will be about 700 tons, and with its load

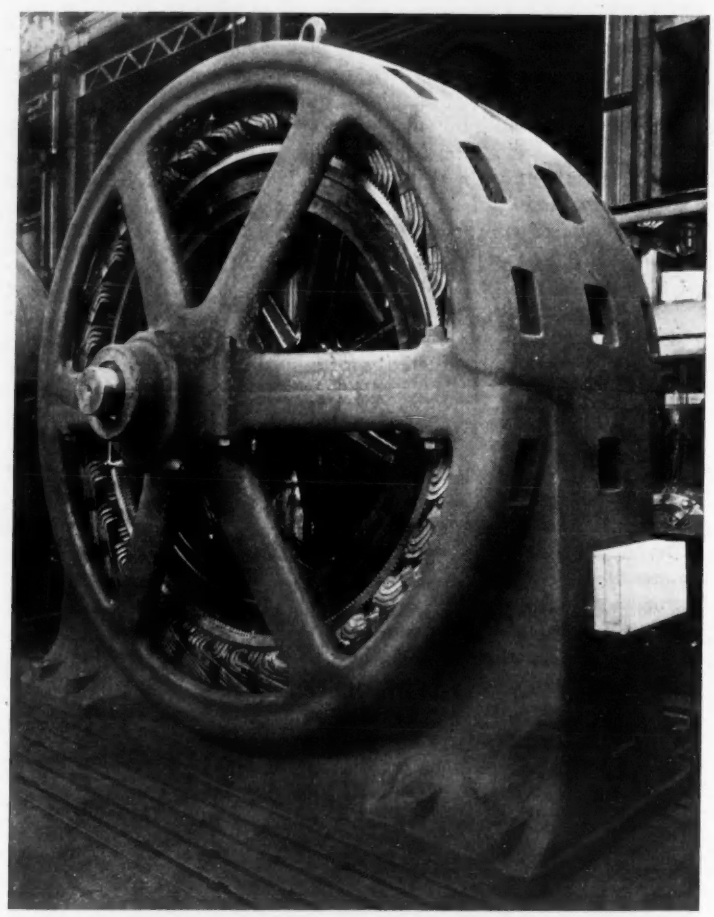


FIG. 1.—850-HP INDUCTION MOTOR FOR PARIS EXPOSITION.

about 1000 tons. The high-speed platform will have a net weight of about 1500 tons, and when loaded about 2300 tons.

The two 850-hp type "C" motors, shown in Fig. 1, will be direct-connected to two 600-kw Westinghouse direct-current generators, which will supply current for about 150 Westinghouse direct-current motors, series wound, each one of about 5-hp capacity and wound for 500 volts. These motors will operate the platforms by means of two sets of gears, driving a shaft upon which are mounted two pulleys of different diameters. All the motors will be in parallel.

The 850-hp motors are constructed according to the standard

Westinghouse practice, which is the same in essential elements whether the motor is of 2-hp or of any larger capacity. The primary element consists of a hollow cylinder built up of laminated rings of sheet steel, mounted on the inside to receive the conductors. The rings are not continuous, but are made up of segments which are dovetailed and fitted into corresponding slots in a hollow cylindrical shell of cast-iron, the shell being held in the cast-iron frame of the motor. The conductors are machine-wound coils of wire thoroughly insulated before being slipped into the slots of the primary iron core. The secondaries of these machines, illustrated in Fig. 2, are built up of laminated steel discs mounted upon an open spider, and carried in slots around the periphery are the rectangular copper bars of the winding. The whole secondary is simple, rigid and durable, as may be seen by reference to the enlarged view shown in Fig. 3. The conductors of the secondary are all purposely short-circuited, hence no accidental short circuit can occur to cause injury to the windings. The construction is practically indestructible from heating, raising of coils or mechanical injury in handling. The advantage of so simple and substantial a

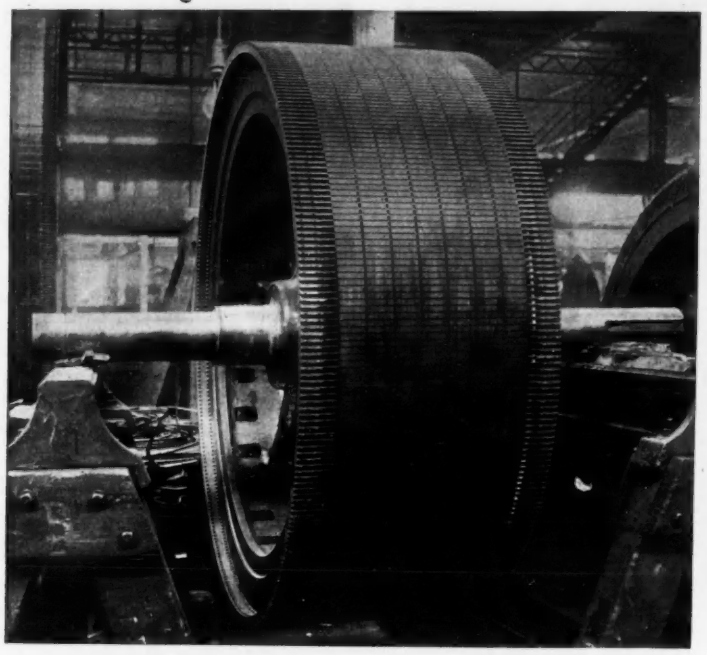


FIG. 2.—SECONDARY ELEMENT OF INDUCTION MOTOR.

construction without moving contacts and switching devices has led to a wide use of these induction motors.

The large motors for the Paris Exposition are wound for 5000 volts, three-phase, having ten poles, and running with 3000 alternations per minute. For starting these outfits there have been provided two 30-kw Westinghouse 500-volt exciters, direct-connected to the two induction motors, taking current from the outside circuits through step-down transformers. The method of operation is to start the exciter, and with the current from it to start one of the large outfits by running the direct-current machine as a direct current motor, thus bringing the 850-hp induction motor to its proper speed, when it may be connected directly to the 5000-volt lines. This method of starting was adopted because direct current from the small motor generator is always available for starting, and no starting apparatus is required for the alternating motor. By separately exciting the generator the field can be regulated from 50 volts up to 500 volts, and by this gradual variation of the exciting current a gradual increase of the generator voltage is obtained, and consequently a smooth starting of the sidewalk.

The two direct-current generators driven by the motors have a full-load rating of 550 volts and 1090 amperes, operating at a speed of 290 r. p. m. The 150 5-hp motors, which directly operate the sidewalk, are wound for 500 volts. The whole of the machinery for this sidewalk is electrically operated and will be under the direct control of the switchboard attendant. Either of the two exciting units is of sufficient capacity to start up the generator, or to excite the two generators at the same time. To use the one or the other there is a triple-pole double-throw switch for the direct-current circuit. To start the motor-generator, the double-pole switch is closed and also the single-pole switch, the resistance of the starting rheostat is gradually cut out, and thus the motor-generator group is brought up to speed. By means of the field rheostat the speed may be further regulated until synchronism is reached; then the three automatic high tension circuit breakers are closed, thus connecting the motor to the incoming circuits.

In starting the sidewalk, the voltage of the direct-current generator is made very low, all switches and circuit breakers in the feeder circuits are closed, and successively the circuit-breaker and

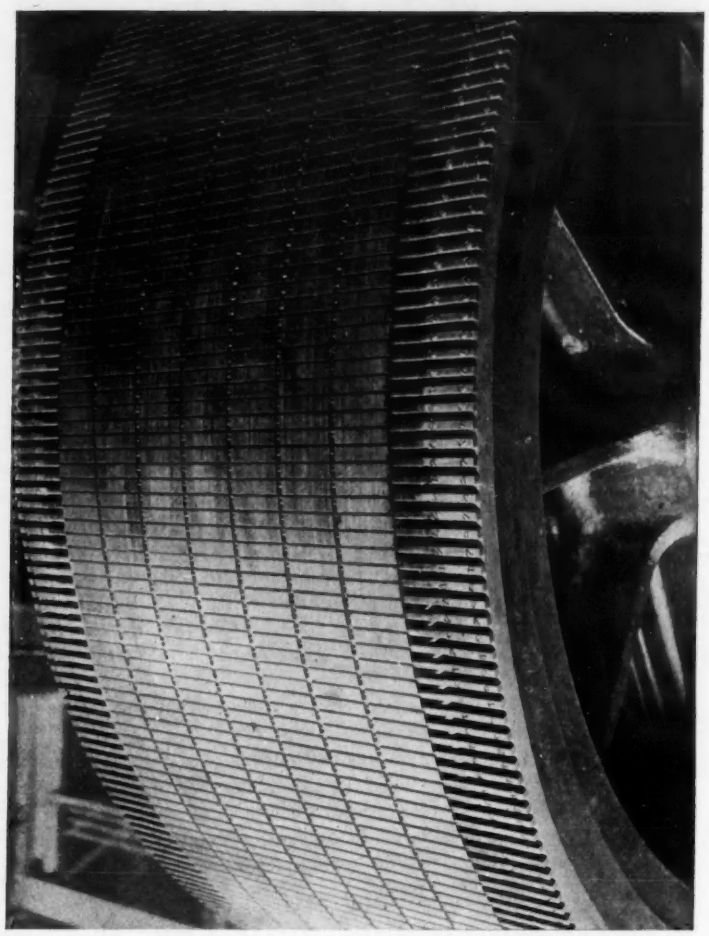


FIG. 3.—ENLARGED VIEW OF SECONDARY ELEMENT.

single-pole switches in the generator circuit. The resistance of the field rheostat is taken out gradually and slowly, thus increasing the voltage of the generator and also of the motors driving the two platforms. Thus the speed of the platform is increased gradually until full speed is obtained. As soon as the voltage of the generator is equal to that of the exciter, a switch is closed, and by operating another switch the generator is made self-exciting. Finally, the exciter switch is opened, and the exciter outfit may be shut down.

General Electric Fan Motors for 1900.

A number of improvements in the mechanical and electrical design have been introduced into the 1900 fan motors of the General Electric Company. Among these may be noted the method of lubrication in which the oil cups feed the bearings by means of a wick held against the shaft by a light spring. Any oil escaping from the bearing is collected in a shield and returned to the oil cup, as shown in the illustration. This oil shield also encloses the fan hub, which is grooved to prevent the creeping of oil. The improved oiling device is used on both direct and alterating current motors.

The rear guard wire and the supports of the four-blade fans have been considerably strengthened this year to prevent any distortion of the guard due to careless handling. With the wall-bracket motors a feature of considerable value is the separate bracket, a number of which may be mounted in various parts of a house, as for instance, in the dining rooms and sleeping rooms, but one motor being used with the different brackets. All the

trunnion motors are now provided with a notched clamp, which prevents any movement of the motor after the thumb screws are tightened.

The alternating-current desk motors are made with swivel frames and with swivel and trunnion frames. Both of these forms have a three-point regulating switch, which is operated by a projecting

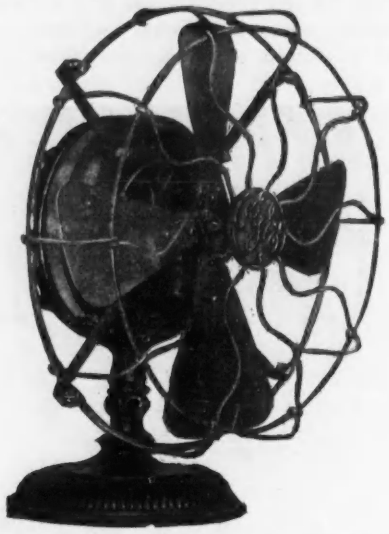


FIG. 1.—SWIVEL-FRAME ALTERNATING CURRENT DESK MOTOR.

key at the back of the motor. The wall motors have regulating switches in the brackets.

These motors are made for 52, 104, 110 and 220-volt circuits. It is worth noting that 110-volt motors may be used on higher voltages up to and including 115 volts. The cycles on which the alternating-current motors may be used are 60, 125, 133 and 140.

The direct-current fan motors have a dustproof, elliptical body, which completely encloses the armature, fields, commutator and brush-holders. A light shield covers the back of the motors, and its removal permits the examination of the commutator and brush-holders. The brush-holders are something of a departure from the general design of those used in other fan motors. One notable feature is the use of a rectangular brush, which, when fitted to the commutator surface, wears evenly and, of course, cannot turn to present a sharp edge to the commutator—a condition frequently

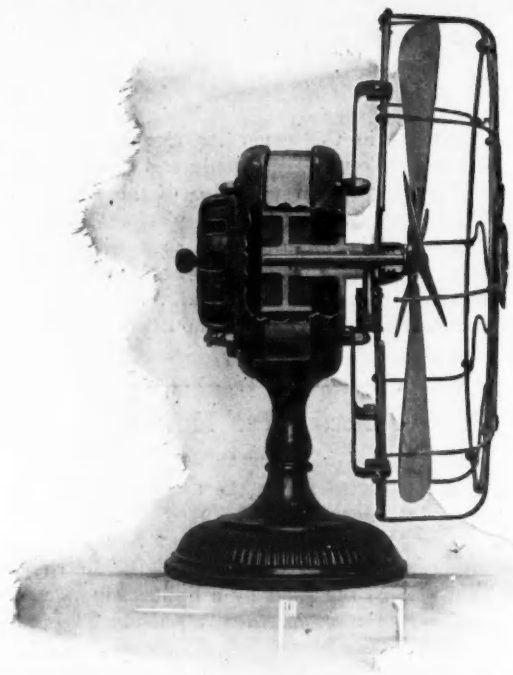


FIG. 2.—SHOWING CONSTRUCTION OF BEARINGS, OIL CUP AND OIL GUARD, WITH GROOVES IN FAN HUB TO PREVENT THROWING OIL.

found when examination is made of motors having the round pencil brushes. The brush-holder is practically a miniature of the form used extensively by this company in large motors and generators, the arms being so hinged that pressure is constant throughout the life of the brush. The motors are provided with three different speeds—the four-point regulating switches being located in the base of the desk motors and in the brackets of the wall motors.

The direct-current desk motors are made in three sizes, with 12-inch, 14-inch and 16-inch fans, the 12-inch motors being made with solid and with swivel and trunnion frames. The bracket motors, with 12-inch and 16-inch fans, are provided with trunnion

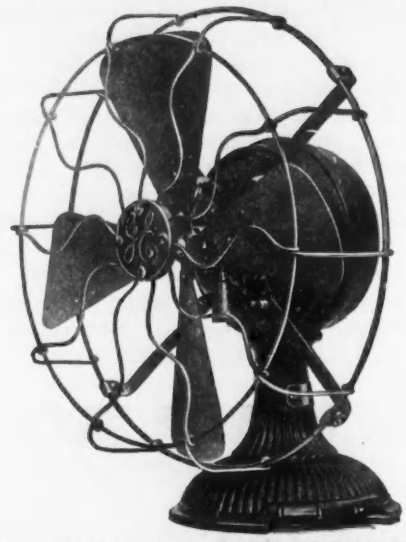


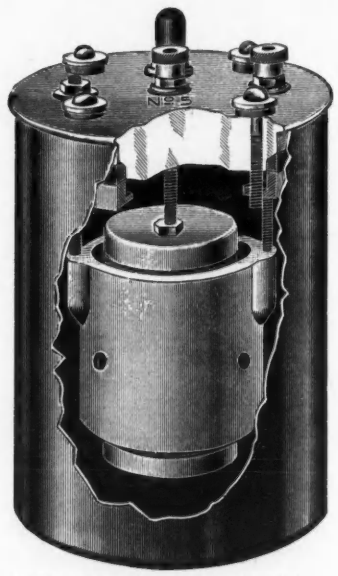
FIG. 3.—SOLID-FRAME DIRECT-CURRENT DESK MOTOR.

frames and separable wall brackets. The direct-current motors are made for 115 and 220 volts, the 115-volt motors being suitable for any voltage between 105 and 125 and the 220-volt motors for any voltage between 210 and 250.

The special bracket motors are designed for use on light partitions which have a tendency to vibrate and act as sounding boards. This motor is supported from its bracket by four springs and runs very quietly. A 10-inch fan is used, only one speed being possible. The snap switch is located on the wall plate on the bracket. The attractive design of this motor makes it especially suitable for locations where something more ornamental than the standard motor is desired.

Nungesser Primary Battery.

The Nungesser Electric Battery Company, of Cleveland, has brought out a new portable primary battery, designed especially for electrical ignition on gasolene propelled vehicles and launches, which is represented in the accompanying illustration. The jar is



AUTOMOBILE PRIMARY BATTERY.

made of seamless, stamped steel, heavily enameled inside and outside, and the cover is of vitrified porcelain. Four round head screws pass through the porcelain cover near the outer edge, which screws raise and lower a malleable iron compression ring. Turning the screws with a screwdriver to the right raises the compression ring and compresses a soft rubber gasket, which com-

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pression, owing to the specific construction of the cover, forces the soft rubber gasket against the inside wall of the steel jar with great pressure. This makes the battery absolutely air-tight and liquid tight.

To provide for the vibration of the elements in portable use, soft rubber bushings are used in the porcelain cover, making a perfect liquid-tight joint, and preventing the rods being rigid in the porcelain cover, thereby avoiding crystallization or breakage of the copper rods due to vibration.

In this sealed and air-tight battery no oil is required on the solution. In all closed-circuit batteries having an alkaline solution not perfectly air-tight and liquid-tight, it is necessary to use a heavy paraffine oil on the solution to prevent the solution from creeping and from decomposing, which it will do, if allowed to remain in contact with the atmosphere. The most serious results from the use of oil on the solution in portable batteries, which are frequently subjected to very rough usage, are caused by the oil coating the copper and zinc elements. When the elements are thus coated with the oil the batteries appear exhausted and practically unfit for use.

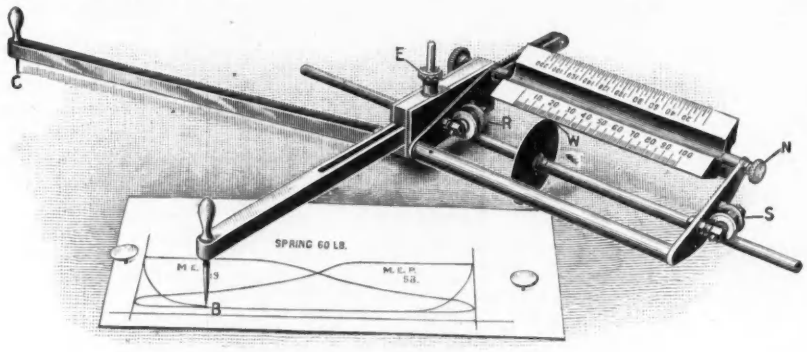
The type of battery used on motor carriages is claimed to have a mileage capacity of not less than 3500 running miles. Its weight when ready for use is seven pounds per cell.

Improved Willis Planimeter.

The main feature of the Willis planimeter for measuring irregular areas is that the recording wheel has an axis perpendicular to the tracing bar, instead of parallel, as in the usual planimeter. Thus the wheel, *W*, rolls for all movements parallel to the tracing bar and gives to its steel spindle a transverse motion for perpendicular movements. In tracing a closed curve from the initial point and back the final position of the wheel with respect to a scale will register the mean ordinate of the irregular area, as may be mathematically demonstrated.

The scale in the improved Willis planimeter is triangular is section, with six graduated edges, so that the instrument will record direct for six different scales of ordinates—in the case of indicator cards, for six different springs.

The recording wheel is made of steel and has a sharp edge, which takes firm hold upon the paper or material upon which the instrument is operated, the long steel shaft of the wheel gliding freely beneath the rollers *R* and *S*, which practically bear the weight of the instrument, and thus make it frictionless. This construction gives great ease of movement, and the instrument is handled as readily on a rough table as on the finest paper. As the rotary movement is not registered, it is apparent that the accuracy



WILLIS PLANIMETER.

of the instrument is not affected by the character of the paper or material upon which the instrument is operated, or by any slight reduction of the diameter of the wheel or injury to the knife edge, which is one of the most important points to be considered in the selection of a planimeter.

Facility for packing has been obtained by detaching the wheel and scale frame from the body of the instrument, so that the instrument packs neatly in a leather-covered case, 1½x3½x9½ inches, which can be readily carried in the pocket. In the usual type of planimeter two delicate points are provided, generally at the top of the instrument, for setting to the card length, one of these points being in line with the axis of the radial bar, while the other is a continuation of the tracer-point. If these points are not spaced to a nicety, or if either one or the tracer bar is bent, the instrument of necessity is proportionately inaccurate. Any possibility of error from this cause has been overcome in this instrument by the use of a depressible pin, *E*. The pivot screw is made hollow, and by means of a small knob a sharp point may be protruded for convenience in setting to the card length while a small spiral spring normally holds it in a protected position after the setting operation has been completed. It will thus be seen that any bending in the tracer point would be compensated for in every setting, and could, therefore, occasion no error, which guarantees initial and continued accuracy.

The triangular scale can be readily detached by unscrewing the milled head screw, N, and any one of its six edges thereby brought next to the wheel. The arms, body and frame of the instrument are all brass, full nickeled; the recording wheel, spindle, rollers, operating points and bearings are all finished steel, and the instrument as a whole presents a neat and pleasing appearance. It is strong and will stand hard usage. No vernier is provided, for the reason that it is believed that the unavoidable error in tracing makes such a refinement unadvisable, and that better and more reliable decimal figures can be obtained by tracing the card two or three times and dividing the total figure thus obtained by the number of times the card is traced. In general it can be safely stated that the planimeter is more reliable in its readings than the cards it is called upon to trace, or the manual skill of the person who traces them. The instrument described is made by Jos. L. Robertson & Sons, 204 Fulton Street, New York.

Paragon Electric Fans.

The 1900 type of Paragon fan motor contains some marked improvements, made up entirely of the smallest details, such as improved bearings, oilers, guards and general finish. Externally the improvement is quite apparent, as will be seen by reference to the cut shown herewith—a general rounding off of awkward corners, a heavier and stronger guard and inverted oil cups all helping to make a fan of much symmetry and beauty.

This year's line includes three types of ceiling fans, differing but slightly in construction, but from the various finishes adapted to every use. Types *A* and *B* are equipped with ball bearings, a heavy

FIG. I.—PARAGON DESK FAN.

ornamental brass shell, and having blades above the motor and switch on bottom. Type *C*, while not differing electrically and mechanically, is finished in plain black enamel with gold striping; it has blades below the motor and is without an individual switch, being intended to be controlled by a wall switch.

The usual 12″ and 16″ desk fans, as well as 12″ and 16″ bracket fans, have what is known as a searchlight joint, allowing free movement in every direction. They are wound for all commercial circuits, 115, 220, 230, 250 volts and ceiling fans for 500 volts, and tested to operate satisfactorily on circuits 5 per cent. above or below their rated voltage.

The armature is built up of plates of the best grade of electric

steel assembled and riveted upon a brass tube, thus avoiding the use of clamping nuts and their liability to work loose. The core is thoroughly insulated, and after winding the whole is saturated with insulating varnish and thoroughly baked, each armature passing two inspections for insulation.

Rectangular carbon brushes are used, their advantage over the round or pencil brushes being that they cannot turn in the holder, but when once fitted to the commutator must always maintain an even contact of the full area of the brush. "Wick Feed" oilers have been used for years by various manufacturers, but it has been found that the wick had a liability to buckle and stick in the cup. This objection has been obviated by the use of a tube embracing the wick, and of sufficient length to support it in proper alignment, and thus with the self-aligning bearing give ample lubrication and long life.

The controlling resistance used is of a special high resistance wire wound upon an asbestos tube, which permits of the necessary expansion and contraction, due to heating and cooling; this construction this company has found to be much superior to the use of porcelain or other rigid material. The resistance is supported upon a suitable porcelain base, no fibre or other material influenced by heat being used. The controlling lever has three running steps giving one-half speed, three-quarter and full speed, and is so constructed as

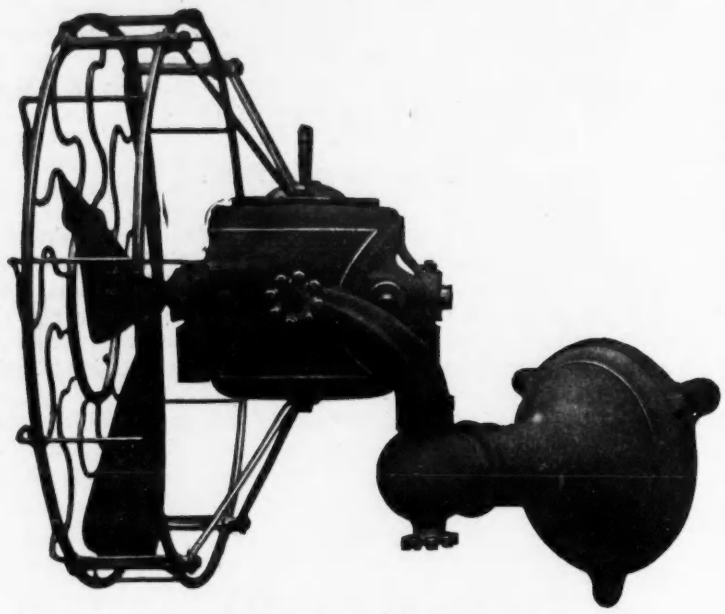


FIG. 2.—PARAGON BRACKET FAN MOTOR.

to give an indication perceptible to the touch in passing from one step to the next.

A special feature in the manufacture of these fans is the elaborate system of test—this being one of the hard and fast rules of the General Incandescent Arc Light Company, which manufactures for the Paragon Fan & Motor Company. Every part entering into the construction is carefully inspected, and every fan when assembled put through the testing department, where a complete record of its performance is made. A fan perfect in the slightest details is therefore assured—a most important consideration in view of the many shipped to Japan, India and our new colonial possessions where repairs would be impossible and where the severest usage is exacted.

The specialties in the fan line made by this company are not shown here, but include an ingenious ceiling fan for yacht use—being a desk fan hung on ornamental brass rod with 24" wood blades and with adjustment permitting movement up and down and completely around. Also the usual column fans for theater and restaurant use where high ceilings make the hanging fan impracticable.

Specialty Water Motor.

The accompanying illustration represents a water motor which is suitable for running all kinds of light machinery, ranging from ¼-hp to 3-hp. Falling within these limits of power requirements may be mentioned telephone generators, static machines, dental lathes and engines, sewing machines, printing presses, etc. The motor is manufacturd by the Specialty Manufacturing Company, Indianapolis, Ind. It is an undershot rotary motor of the jet type with a fixed opening. The wheel and buckets are cast in malleable iron, which prevents the buckets from becoming loose. This is stated to be a common difficulty with motors having the buckets riveted to the periphery of the wheel. The buckets in such construction work loose and frequently fall off.

The bearings of this motor are both in the upper half of the casing, which arrangement permits of taking the machine apart and

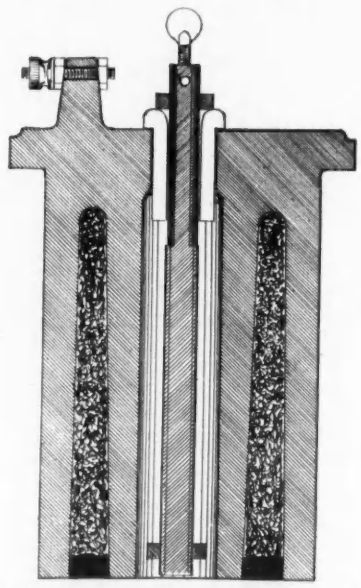
WATER MOTOR.

putting the parts together again by anyone with no mechanical experience. It is impossible to get the shaft out of line, and leaks at the journals are completely prevented.

This motor is made in the following sizes: 8-inch, 12-inch, 16-inch and 20-inch, single, and 20-inch, duplex and triple. It is stated to be a powerful machine and highly efficient, and is recommended for pressures of thirty-five pounds and over.

New Type of Cylinder Carbon Primary Battery.

A new type of cylinder carbon primary cell is being placed on the market by the National Carbon Company, and known as the "Duplex" cylinder cell. In outward appearance the cell does not differ from the ordinary type, but as will be seen in the cut giving a sectional view of the new cell, its peculiarity lies in the hollow walls of the cylinder, which are charged with a special depolarizing compound, there being sufficient of the compound in the cyl-



CROSS-SECTIONAL VIEW OF CYLINDER CARBON.

inder to take care of several zincs. In ordinary installations of electric bells, signals, annunciators, etc., and particularly gas lighting, a short circuit is quite likely to occur at any time. With the ordinary type of battery in use, such a short circuit kills it for some little time, owing to lack of recuperative power. Curves of the new cell show, however, that a temporary short circuit would have but little effect on it. For example, after being short-circuited for one hour, the voltage rose to .7 volt after five minutes, attained almost normal value in fifteen minutes and full normal voltage in thirty-five minutes.

Prevention of the Bursting of Water Pipes by Frost.

Last year considerable attention was devoted by the technical and lay press to accounts of the thawing out of frozen water pipes by the application of electric current. Such work appears to have been very successful despite the extreme severity of the weather, but some observant people were led to wonder whether prevention might not be better than cure.

Among these was Mr. Nevil Monroe Hopkins, well known to the readers of this paper through his various contributions in the past and other work. He read not long since a paper before the Franklin Institute, Philadelphia, in which he described an ingenious pneumatic system for the prevention of the bursting of water pipes through freezing. This system is Mr. Hopkins' invention, the United States patents on which have been assigned by him to the Pneumatic Dome Manufacturing Company.

As is well known, the bursting of pipes is due to the expansion of the water as it is about to freeze, when its volume increases about 10 per cent. The expansive force of freezing water has been utilized to break up heavy ordnance as it becomes obsolete, the cannon bursting with loud detonations when the water congeals. It is also well known that ice under pressure becomes plastic and can be moulded into various shapes. This peculiar property, together with the expansive force above alluded to, forms the basis of Mr. Hopkins' invention. The system depends for its operation upon the elastic cushioning of the pipes at intervals with air, by means of air domes with inclined planes, or slopes, opposite the mouth of the storage dome.

In Fig. 1 is shown a horizontal dome, the dimensions of which have been determined by careful laboratory measurements, taken in combination with the percentage of ice expansion. Owing to its viscous behavior the ice slides along the bore of the pipe until it strikes the double slopes or inclined planes, when it is slid up into the storage room of the dome, simply compressing the air instead of bursting the pipe. The dome for vertical pipes provides, in practically the same manner, cushioned storage room for an in-

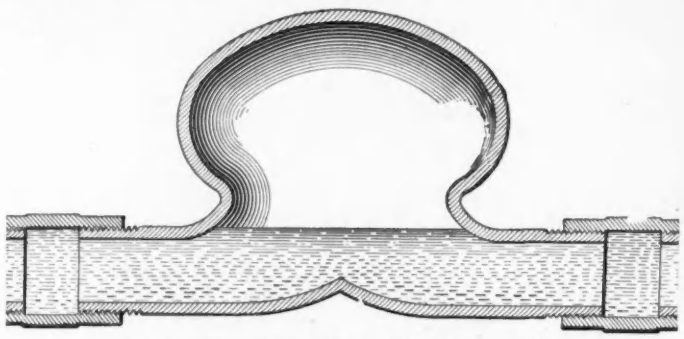


FIG. 1.—THE HORIZONTAL PNEUMATIC DOME.

crease in bulk due to freezing. The column of ice in expanding longitudinally thrusts its end into the air dome without the necessity of being deflected.

Both the horizontal and vertical domes are attached to the pipes by ordinary screw couplings. These are let into the pipe every ten feet on a long stretch, and on every exposed vertical run of less than ten feet.

Apart from the prevention of the bursting of pipes an important advantage claimed for the system consists in rendering the water flow steady and noiseless under all conditions because of the air cushions. In order to secure a perfect elastic cushion wherever the pipe is exposed an automatic air inspirator is provided. The sectional view (Fig. 2) gives a clear idea of the construction of the inspirator and its operation in combination with a pneumatic dome. The tapering nozzle shown at the right hand causes the water to flow more rapidly at the point where it enters the little conical compartment and produces a vacuum there. Air immediately rushes in from the little opening at the top of the apparatus and is forced into the pipe. When the flow stops, however, the vacuum fills with water, which goes into the small cylinder above, where it lifts the little copper float and shuts the valve. On again opening a spigot, the flow generates another vacuum about the nozzle, the water in the cylindrical top is drawn down and the valve again opens for the admission of more air. A hygienic advantage claimed for this system is the purification of the water by the air which is forced into the pipes.

Mr. Hopkins has, as stated, assigned his United States patents in this invention to the Pneumatic Dome Manufacturing Company, 502 E Street, N. W., Washington, D. C., by whom the device

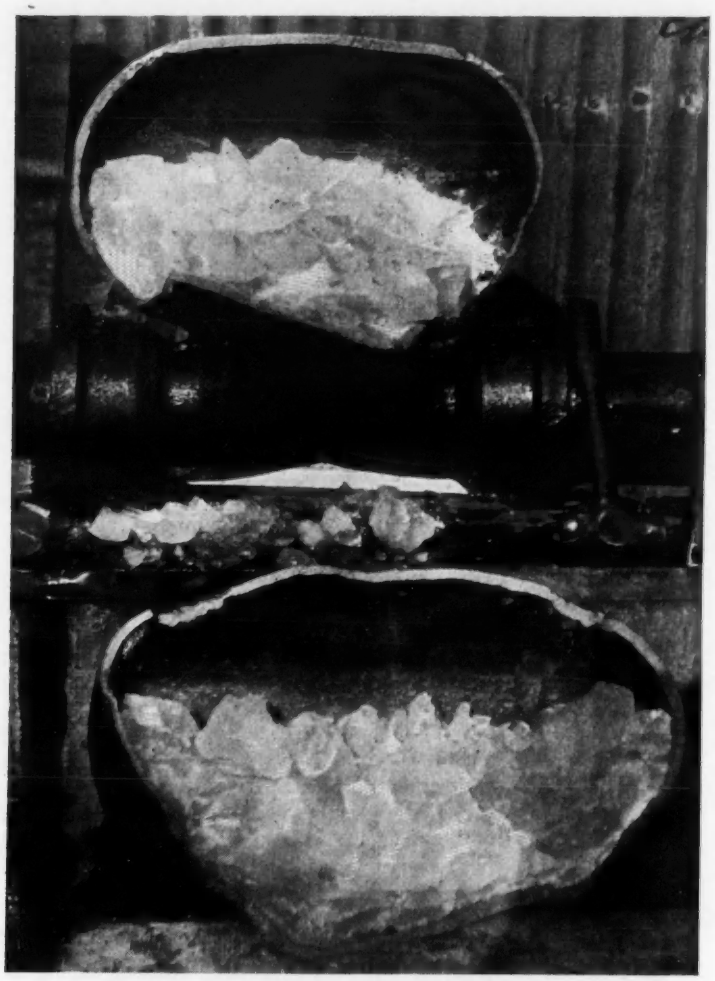


FIG. 3.—INTERIOR VIEW OF PNEUMATIC DOME, BROKEN OPEN.

is now being placed upon the market. A number of tests have been made lately which indicate its practical utility. Fig. 3 shows an interior view of a pneumatic dome, intended for the protection of four-inch street mains, after it had been frozen and then broken open with chisels. The increase in bulk of the water due to the freezing is seen to have been taken care of quite safely, and the pipe to be uninjured. This experiment was conducted under the supervision of the Philadelphia City Water Bureau. The freezing was continued for nine days, at a temperature of 3 degrees below zero. The ends of the pipe were closed with heavy plugs locked in position, allowing no room for expansion except that which occurred within the dome. A pipe not thus protected was subjected to the same treatment and burst in a few minutes. Tests with smaller pipes, down to diameters of one-half inch, ended with equally satisfactory results. The dome has already been placed in several United States buildings and in the White House, Washington, by order of the Chief of Engineers.

FIG. 2.—LONGITUDINAL SECTION OF AIR INSPIRATOR.

New Erie Ball Engine.

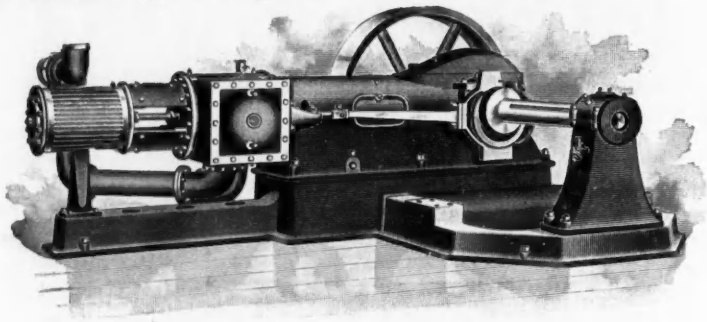
The accompanying cut illustrates the latest addition to the line of engines built by the Ball Engine Company, Erie, Pa., consisting of an automatic, enclosed self-oiling tandem-compound engine. To satisfy the demand for an engine that shall not only give perfect regulation under all changes of load, but shall be automatic in its oiling as well, the above firm found it necessary, after a series of experiments, to design a new engine entirely. In it larger proportion and increased strength have been combined with graceful outlines. The same governor and cylinder parts furnished with the standard engine are used in the new type, but many new features have been added in the design of the other members.

A large pocket in the crank end of the frame is filled with oil to such a level that the shaft discs just touch the surface. While the engine is at rest the whole system of oiling is inoperative, but with the first turns of the fly wheel a stream of oil is thrown over the guides and connecting-rod boxes and continues as long as the engine is in motion. A trough around the upper portion of the crank chamber catches a supply of oil and passes it to the main journals, which receive copious lubrication. These bearings are so constructed that, while not a drop of oil reaches the outside of the engine, the engineer may at any time watch the flow of oil or feel the journals.

The guides are of the bored out type, and by means of a special construction of the bed the crosshead constantly floats in oil. This feature, together with the large bearing surfaces, practically eliminates wear in these parts, and the makers state they can show engines of their make built with this construction which have been in constant operation for a number of years with the original tool marks in the guides still intact. It will thus be seen that two strong points in favor of this type of engine are an extremely low friction and a great saving in oil.

On each side of the frame doors are provided, and in the crank end is a hand-hole plate for easy access to the working parts. In addition to these openings, the removal of the corrugated hood on top lays the shaft and connecting rod bare for inspection or adjustment.

Across the interior of the engine, between the discs and the guides, are two vertical plates, so placed as to allow the connecting rod to work freely between them. By their construction and position they direct the oil in a straight line to the crosshead, and work a two-fold benefit—they limit the amount of oil thrown to the guides to just enough for proper lubrication, and they allow the engine to be run with the side doors removed without the slightest danger of a drop of oil reaching the engine room floor. This will be found of much value when taking indicator cards or when watching the internal working of the engine.



NEW ERIE BALL ENGINE.

If the proper ventilation of the interior of an engine is a necessity in the ordinary type, it is evidently of much greater moment to keep the working members at an even temperature where they are completely incased and the lubricant is constantly flowing over them. In the present engine this problem has been solved by providing a chamber in the cylinder end of the frame which prevents the oil from coming in contact with the heated surfaces of the cylinder head. Openings on each side allow the air to circulate freely and leave the piston stuffing box in full view. This chamber also forms a receptacle for the hot water of condensation from the piston stuffing box, as it was considered better to prevent this water and oil coming together at all than to allow them to mix and then provide means for their separation.

The main shaft bearings are placed within the frame and have top and side adjustment. The crank shaft is a one-piece forging of the best open hearth steel. The crank pin is turned out of the solid and all bearings are ground perfectly round and true. Cast-iron discs of the proper weight are securely fastened to the bells and keep the reciprocating parts in perfect balance. All cylinder heads have steam tight ground joints to the cylinders.

The construction of the head which connects the two cylinders is worthy of especial notice. Two conical shells with tongue projections fit into grooves in the high and low-pressure heads. Bolts passing through the tongues and grooves give to the whole the strength and rigidity of a single casting. This construction not only takes all shearing stress from the bolts but allows the rapid dismembering of the head for examination of either cylinder with the assurance that when reassembled every part will regain its exact original position.

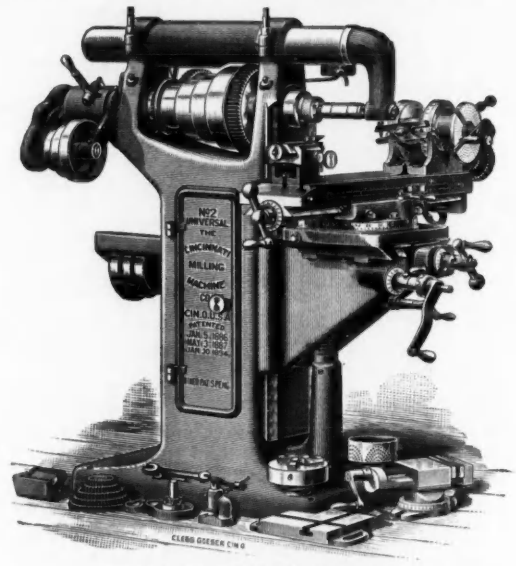
The greatest factor to be considered when determining the economical qualities of an engine is the steam distributing valve, and the telescopic valve of the Ball engine is so constructed that it follows up its own wear and remains steam tight throughout its whole life.

The engine shown in the illustration is fitted for use in electrical generation, having the base and shaft extended together, with an outboard bearing ready to receive a dynamo.

Universal Milling Machines.

The illustration herewith represents a new line of "Cincinnati" Universal milling machines. The carriage swivels on its saddle, permitting the table to be turned at any angle. The means for adjusting and operating the machine are so located and contrived as to consume the least possible time of the operator. The shaft for vertical motion is placed at an oblique angle and carrries a clutch crank. This arrangement of shaft in connection with permanent handles on screws for cross and longitudinal adjustment of table, gives the operator control of every adjustment without the necessity of changing his position or shifting handles. Two adjustments may be made simultaneously. The table is provided with a quick return and thus with a handle at each end of the table, the operator is enabled to move the table while standing on either side of the machine.

A distinctive feature of these machines is the circular form of the swiveling carriage for table. It is apparent that the swiveling carriage need not be drawn out from the face of column to the same



UNIVERSAL MILLING MACHINE.

extent as when made square, permitting at the same time the use of a shorter cutter arbor. Again, the swiveling carriage always has a large bearing on slide on top of knee, no matter at what angle the table is set. This permits a most effective method for clamping the swiveling carriage to slide on knee. The table may be revolved through 360 degrees. These machines not only have an automatic longitudinal feed to table, but also automatic cross feed in line with spindle. In the Universal head provided, the spindle has a clamping device by means of which it can be firmly locked during the cutting operation.

The Cincinnati Milling Machine Co., of Cincinnati, Ohio, manufacturers of these tools claim that in accuracy and durability as well as in productive capacity the machines are unequaled, and that they are in extensive use in the largest electrical manufacturing concerns of this country and Europe.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET was but a trifle less dull than that preceding it, and showed barely one-third of the business done a year ago in stocks, while in railway bonds only $8,000,000 were sold as compared with $21,000,000 in the same week last year. It is, however, rather a dull and waiting market than a weary and depressed, and the general conditions are all such as would dispose to great activity at the proper moment. Railroads are doing well, and the "coalers" are in particularly good shape, while Southern properties in general are benefited by the high price for cotton. During the week Western Union, on 3050 shares, again sold off 1 to 83½, and on 4310 shares, General Electric went off ¾ to 127. Street railway securities were generally weak, on franchise tax talk, and sympathetically in the Third Avenue, which again made the terrific drop of 20⅜ to 75⅝ on sales of 175,265 shares—a drop of nearly 175 in about a year! Brooklyn Rapid Transit on 54,800 shares was off 2¼ to 69¾; Metropolitan declined 2¼ to 174, and Manhattan Elevated went off 2 to 96. In Boston, American Bell Telephone closed at 330; Erie, 119; Mexican, 3; Michigan, 100; New England, 135-140; Boston Elevated, 120; West End Railway, 93 com., 112 pref.; Westinghouse Electric, 42. In Chicago, the closing quotations were Union Traction pref., 75-75½; Metropolitan Elevated, pref., 78; Northwestern Elevated fives, 99½; Shelby Tube, 16½. In Philadelphia, Elec. Storage Battery closed at 88-92, com., 90-94, pref.; Penn. Elec. Vehicle, 7-8 com.,3-3½, pref.; Gen. Elec. Automobile, 3½-4; American Rys., 3¾; Elec. Co., of America, 13½; Philadelphia Traction, 98¼; Union Traction, 37⅝; Philadelphia Elec. Co., 5¾. In the New York outside markets, closing prices were: Elec. Boat, com., 17-20, pref., 30-35; Elec. Vehicle, com., 40-44, pref., 70-90; New York Elec. Vehicle, 8¼-8¾; New England, 5½-6; Illinois, 2½-2¾.

NEW YORK & NEW JERSEY TELEPHONE.—The report of the New York & New Jersey Telephone Company, operating in New Jersey and Long Island, for the year ended Dec. 31, is issued. The figures show as follows:

	1899.	1898.	1897.
Gross earnings	$2,381,368	$2,058,477	$1,790,287
Operating expenses	1,618,191	1,433,476	1,236,819
Net	763,177	625,000	553,467
Charges	141,556	127,683	109,305
Balance	621,620	497,313	444,162
Dividends	398,850	315,622	272,420
Surplus	222,770	181,695	171,741

President Cutler says: There was expended for extensions during 1899, $1,006,793; for maintenance and reconstruction, $694,252. The additional investment in real estate amounted to $142,615. During the year the company sold 1720 shares of treasury stock, bringing the issued capital up to $6,000,000. On Jan. 1, 1895, the total number of stations operated was 10,102; on Jan. 1, 1900, the number was 28,073. The company's total surplus Dec. 31, 1899, amounted to $1,933,112. The company is doing a great deal of new work and extending rapidly.

NEW ENGLAND ELECTRIC VEHICLE.—It is stated that the New England Electric Vehicle and Transportation Company has between $8 and $9 per share in quick assets, in addition to the 100 vehicles on hand. The stock is selling at $6 per share, with $10 per share in cash paid in. The company is adding new vehicles to its equipment, which at present consists of 20 hansoms, 40 broughams, 30 open vehicles, and 10 delivery wagons, under contract to a department store. Ten additional broughams will be delivered within a few days and five additional delivery wagons. It is estimated that 50 additional delivery wagons could be immediately placed in service. The company's livery service is very popular and it is obliged to turn away as many calls as it is able to answer. It is rumored that the capital stock of $25,000,000 may be reduced to $5,000,000, as in the case of the Chicago and Washington companies. By next fall the company will have 250 vehicles in operation and with this equipment the company should be able to make a good showing.

THE ST. LOUIS RAILWAY—Brown Brothers & Co., of New York, purchasers of all the street railways in St. Louis with the exception of the St. Louis & Suburban system, have declared another dividend on their subscriptions resulting from the sale of securities. The amount of the dividend is not known, but it is understood to be at least 40 per cent. on $23,000,000, the amount of the bond issue. Of the $23,000,000 issue it is estimated that fully 75 per cent. is held in St. Louis. The syndicate recently paid a dividend of 15 per cent. from the proceeds of the sale of bonds and this additional dividend will make a total of 55 per cent. paid, provided the coming dividend is to be 40 per cent. The same accommodations provided for St. Louis holders of certificates as were provided before will be provided this time. Notice was received that the subscription certificate transfer books were closed at Brown Bros. & Co.'s office in New York, on Feb. 27, and will reopen on Tuesday, March 6.

SUNSET TELEPHONE MORTGAGE.—A $2,500,000 mortgage has been given by the Sunset Telephone & Telegraph Company to the Old Colony Trust Company, of Boston. The mortgage covers all the Washington and California holdings of the company, and is given to secure $2,250,000 worth of five per cent. gold bonds. The bonds are $1,000 each, and are payable Oct. 1, 1929. Any time after October, 1913, they may be taken up. On Oct. 1 of each year from 1909 to 1928 the telephone company agrees to pay $15,000 on the bonds.

ALBANY-TROY STOCK.—The New York State Railroad Commission has approved an application of the United Traction Company, of Albany and Troy, for authority to increase its capital stock from $4,000,000 to $5,000,000. The proceeds of the sale of the new stock will go toward purchasing new cars and equipment for the Troy division of the road, and to pay off $399,300 debenture bonds of the former Troy City Railroad.

NORTHWESTERN "L" ROAD'S BONDS.—The $5,000,000 Northwestern (Chicago) Elevated bonds, offered to the stockholders, have all been subscribed. The Columbian Construction Company stockholders took $4,000,000, and the remaining $1,000,000 was taken by investors. This loan was underwritten by Blair & Co., and the Illinois Trust & Savings Bank, of Chicago. This is the system which about one year and a half ago Blair & Co. furnished $4,500,000 to complete, and through the sale of these bonds the loan was paid off. This leaves the company with $5,000,000 first mortgage bonds, $5,000,000 preferred and $5,000,000 common stock. The stock is in a voting trust, of which the trustees are John J. Mitchell, Marshall Field and James A. Blair.

METROPOLITAN REPORT.—The report of the Metropolitan Street Railway Company for the quarter ending Dec. 31, showing an increase of $472,926 in gross earnings and an increase of $182,485 in net earnings, is considered a favorable exhibit. For a considerable time past the company has shown something like $150,000 increase per month in gross earnings, and in view of this fact the last report was considered about normal. When the facilities for carrying passengers on the system are complete a large increase in traffic will be the result. It is estimated that if earnings continue on the present basis during the remainder of the fiscal year, something like 11 per cent. will be earned on the stock.

PITTSBURG TRACTION.—It is stated that the combination of several Pittsburg Traction lines into the Union Traction Company has been practically accomplished and that the capital of the new company will be in the neighborhood of $100,000,000. There is a rumor that the dividend rate on the preferred stock of the consolidated company will be increased to 7 per cent. per annum, and that $15,000,000 of the common stock will be put on a dividend paying basis.

PENNSYLVANIA ELECTRIC VEHICLE COMPANY.—At the annual meeting of Pennsylvania Electric Vehicle Company the treasurer's financial statement showed receipts were $20,851; expenses, $19,653; net cash balance in hand was $320,000; the amount that has been called on the preferred is $400,000. The company is to increase its equipment as rapidly as possible.

CANADIAN BELL TELEPHONE.—The statement of the Bell Telephone Company of Canada for the year ended Dec. 31, 1899, shows a total income of $1,456,683.06, and expenses of $1,103.375.66. The dividends paid during the year, and including January of this year, amounted to $312,920, leaving a surplus of $40,387.40.

CHICAGO TRACTION DEAL COMPLETE.—The deal between the Union Traction and Consolidated Traction companies was closed last week. Mr. Yerkes will receive $4,500,000 in 4½ per cent. bonds for the $10,000,000 of stock he holds. The Consolidated capital is $15,000,000.

LAKE ORION RAILWAY BONDS.—C. H. White & Co., New York bankers, have purchased the entire $1,250,000 bond issue of the Detroit, Rochester, Rome & Lake Orion Electric Railroad.

MICHIGAN TRACTION BONDS.—The Michigan Traction Company of Kalamazoo has filed a mortgage to secure $600,000 bonds floated by the American Trust Company, of Philadelphia.

Commercial Intelligence.

THE WEEK IN TRADE has been generally good, and if the number of buyers and visitors in New York is any criterion spring trade is to open up early and strong. Railroad earnings are excellent; sixty roads reporting for the second week of February, a gain of 30.4 per cent. over a year ago. Reports from the West and South are encouraging, and now we seem to be adding a large business in coal to our growing export trade in other branches. Bank earnings for the week, five days, aggregated $1,389,295,879, a decrease of 8 per cent. from last week, of 16 per cent. from this week a year ago, but a gain of 16 per cent. over 1898, of 77 per cent. over 1897 and of 30 per cent. over 1892. Outside of New York clearings are 14 per cent. smaller than last week, and 7 per cent. smaller than in this week a year ago. Business failures for the week number 168, as compared with 199 a week ago, 220 in this week a year ago, 183 in 1898, 258 in 1897 and 271 in 1896. In the electrical field a variety of new work is offering, and the Manhattan Elevated is receiving bids until March 15 on the mechanical accessories for its First Avenue power house. Now that the New York tunnel contract has been signed, an enormous amount of work opens up for that, which even at that start will include a variety of electrical apparatus and will in turn develop new work all along its route. Steel rail was steady at $35; copper at 16¼ cents, and lead at 4.70 cents.

PURCHASE OF TELEPHONE SUPPLIES.—The Rocky Mountain Bell Telephone Company has closed a deal with an Eastern firm for 250,000 pounds of copper wire, that being but one-half of the amount of copper wire that will be strung during the year. The delivery will be made at Ogden, Utah, on April 1, to be distributed from that point to the places where it is needed. The contract for all the poles necessary to complete the connection with Denver, has also been closed, the number being based on thirty-five poles to the mile. The poles are purchased in sections of the country contiguous to the places where they will be used. The ox bow between Fort Steele and Laramie is covered by four contracts. Cedar poles cut in Northern Idaho will be used from Ogden to Fort Steele. There are camp outfits and material for three gangs of workmen now on the ground, and the work will be pushed without delay. Between Salt Lake and Denver there will be two through copper wires, and local lines in addition, as fast as called for. It is confidently expected that the through lines will be completed by the first of next November.

SPECIAL ARC LAMPS.—Mr. Charles J. Bogue, the electrical manufacturer, of 213-215 Centre Street, New York City, has recently done some special and interesting arc lamp work in connection with the treatment of diseases by light, a subject now attracting a great deal of attention. A meeting to discuss tuberculosis has just been held under the auspices of the Medico-Legal Society, and Dr. J. Mount Bleyer showed before them a focusing lamp, built by Mr. Bogue, to illustrate his ideas of curing consumption. The lamp was of 25 amp. on 110-volt circuit using 48 to 50 volts with resistance. For Dr. Hopkins, in Brooklyn, who has been similarly experimenting with the use of light in the treatment of cancer, Mr. Bogue has made an 80-amp. lamp with mirror lens. The beam of light in this case is passed through a quartz lens and a water lens. Whatever the results of such treatments may be, the demand on the manufacturer for skill and exactness is by no means slight.

THE BUNNELL TELEGRAPHIC & ELECTRICAL CO. is a corporation recently organized by D. C. Bunnell, Mrs. Jesse H. Bunnell, Charles E. Merritt and Albert J. Wise to manufacture telegraphic, electrical and railway supplies. The company is the owner of all the personal patents of the late Jesse H. Bunnell, and is the sole manufacturer and seller under such patents, particularly those relating to telegraphic apparatus. Mr. Bunnell's family is largely interested in the ownership and management of the new concern, which has also the co-operation of parties of influence in the electrical field. The company has employed a number of skilful workmen and taken the entire building, 110-116 Beekman Street, New York, for a salesroom and factory. This property is being rapidly and fully equipped with modern machinery, thereby enabling the company to compete as to quality and price and to furnish the best facilities for experimental work.

ICE FOR KOBE, JAPAN.—The York Manufacturing Company, York, Pa., have just received contract for a complete 20-ton ice making plant to be shipped to Kobe, Japan. The plant is now being prepared for shipment. The York Manufacturing Company have recently erected and now have in operation a complete malleable iron foundry and fitting shop. This foundry is designed and constructed in accordance with the latest and most improved practice. It is equipped with an air furnace of the latest design, three large annealing ovens, moulding machines, and sand blast apparatus to clean the castings. The fitting shop is equipped with new and modern tools. This new department was added more especially for the purpose of turning out the company's own work, but it has been made of sufficient capacity to furnish castings for outside parties who may desire that work done.

THE NEW YORK TELEPHONE COMPANY is making a minimum rate of $5.00 per month for telephone service for both business and residence use. Frequent reductions have been made from time to time, but the present figure is the lowest that has ever been reached. The result is that there has been a great increase in residence service. The total number of telephone stations in the Borough of Manhattan to-day is in round numbers 40,000. In the last five years there has been an increase of over 27,000 stations, while the year of 1899 alone shows a gain of 10,000. At the present time the rate of growth is over 1000 stations a month, which shows an increase not equaled in any part of the world. Subscribers generally appreciate the message system whereby they pay exactly for the service they get and for that service only.

WESTERN ELECTRIC ENCLOSED ARCS.—The United States Commissioners of the Paris Exposition have chosen enclosed arc lamps of the Western Electric Company's make for lighting the entire American section. These lamps will be placed two in series on 220-volt circuits. They will be of special design and furnished to harmonize with the posts upon which they are mounted. Each post will support a pair of lamps. The posts and railings for the different exhibits are by Chicago designers, the posts being manufactured in the United States. Mr. J. M. Hollister, president of the Chicago Electrical Association, will leave for Paris on March 14, as the engineer in charge of the preparations for the Western Electric Company's extensive exhibit at the Paris Exposition. He will remain in Paris during the Exposition.

NON-POLARIZING DRY BATTERY CO. have held their annual meeting at headquarters in New York City. Mr. J. Leibes, former president and manager, has retired from active service and the business is now under the management of Mr. H. Schroeder, who has been with the concern for the past year. The officers elected for 1900 are E. Martin, Jr., president; Jas. Cruickshank, vice-president; C. N. Brizse, secretary and treasurer. The financial statements were most satisfactory to the stockholders. The business for the past year showed a great increase over all previous ones, and O. K. dry batteries were stated to be a recognized standard of the U. S. Government. The orders coming in at the present time are unprecedented.

CROCKER-WHEELER COMPANY, 39 Cortlandt Street, New York, have recently closed an important contract with the Dixon Crucible Company, of Jersey City, for two 100-kw generating units and about 300-hp in direct-current motors for their extensive works in that place. The order is said to be one of the most interesting of its kind ever placed. A Crocker-Wheeler office for the New England States has been established at 31 State Street, Boston, with Mr. J. Hally Craig as representative. An office has also been opened at 610 English-American Building, Atlanta, for the Southern States, with Mr. Louis P. Hall as representative.

INCANDESCENT LAMPS IN JAPAN.—The Japanese manufacturers are not very happy in manufacturing things in imitation of foreign ways. Most of them ended in failure, but, says the *Japan American Commercial Journal*, the case under consideration seems rather exceptional. Electric light globes are now made in Japan and their quality is not a bit inferior to the imported articles. The Manila government has ordered 100,000 globes from the Tokyo Electricity Company; 60,000 have been ordered from Singapore and 5000 from a certain company in New York. This may be true, but it would be interesting to know where the Singapore 60,000 came from. We know of no lamp works there.

GREGORY ELECTRIC COMPANY, Chicago, reports recent shipments of two 100-kw Edison 500-volt motors to the York Manufacturing Co., Saco, Me.; one 100-kw Edison 220-volt motor to the Union Drawn Steel Co., Beaver Falls, Pa.; one 125-light Excelsior arc dynamo to the Hawey, Ill., Water & Light Co.; two A-70 Thomson-Houston alternators and one 100-kw Westinghouse alternator, besides the usual quota of smaller motors and generators. The month of January showed the largest amount of shipments in the history of the company.

LIGHTING AT TRIESTE.—In our issue of January 6, 1900, we gave a brief illustrated description of the electric lighting system at Trieste, Austria. The Kabelfabrik Actien-Gesellschaft, of Vienna and Pressburg, write us requesting the statement that they furnished all the cables for that interesting plant. The total length of the three-conductor cables thus supplied for underground service was 33 kilometers, or about 36,000 English yards.

NORTHERN ENGINEERING COMPANY, 39 Cortlandt street, T. W. Kloman, president, have recently sent a large number of their motors to London, being one of the many shipments they have made during the past five months to Veritys Company, Limited, their English representatives. The various uses for these motors is not known, but the demand is a large and steady one.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from New York during the week ended February 17: Argentine Republic—163 cases electrical material, $5235; 12 cases electrical machinery, $7807. Antwerp—20 cases electrical material, $2732; 4 cases electrical machinery, $60. Brazil—2 cases electrical material, $19. British Possessions in Africa—18 cases electrical material, $2057. British Guiana—7 cases electrical material, $68. Bristol—20 cases electrical machinery, $15,000. Bremen—1 case electrical material, $15. Berlin—57 cases electrical material, $425. Central America—8 cases electrical material, $164. Chile—27 cases electrical material, $518. Florence—21 cases electrical material, $2452. Glasgow—10 cases electrical material, $1000. London—14 cases electrical carriages, $4080; 89 cases electrical material, $5204. Leith—13 cases electrical machinery, $982. Marseilles—269 cases electrical material, $24,292. Manchester—4 cases electrical machinery, $1037. Naples—1 case electrical material, $66. Peru—13 cases electrical material, $507. Southampton—7 cases electrical material, $663. St. Petersburg—2 cases electrical material, $95. United States of Colombia—9 cases electrical material, $217. For the week ended Feb. 24 the exports were: Antwerp—27 cases electrical machinery, $15,845. Argentine Republic—111 cases electrical machinery, $7804. Amsterdam—224 cases electrical material, $11,675. Berlin—1 case electrical material, $10. Brazil—63 cases electrical material, $2628; 17 cases electrical machinery, $191; 3 cases electrical material, $209. British West Indies—20 cases electrical material, $607. British East Indies—4 cases electrical material, $192. Belfast—2 cases electrical material, $384. British Possessions in Africa—12 cases electrical material, $649. Chile—9 cases electrical material, $76. Central America—30 cases electrical material, $1284. Dutch East Indies—1 case electrical material, $70. Havre—350 cases electrical material, $47,539; 1 case electrical machinery, $77. Japan—15 cases electrical material, $639. Liverpool—170 cases electrical material, $10,017. London—338 cases electrical material, $14,167. Marseilles—65 cases electrical machinery, $4794; 20 cases electrical material, $2331. New Zealand—12 cases electrical material, $302. Puerto Rico—25 cases electrical material, $547. Peru—135 cases electrical material $638. Riga—3 cases electrical material, $567. Southampton—62 cases electrical material, $1024. Uruguay—1 case electrical material, $5. Colombia—8 cases electrical material, $244.

THE COLONIAL ELECTRIC COMPANY, of Youngstown, O., manufacturer of the Colonial incandescent lamp, and the Orient Electric Company, of Warren, O., manufacturer of the Orient lamp, have effected a combination, and the company will be known in the future as the Colonial Electric Company. The new company has accepted a proposition made it by the city of Ravenna and the combined plants will be removed to that city. The new factory is a large four-story brick building, the second largest in the city. The building, grounds and fixtures have been deeded to the company and in return the latter agreed to employ not less than 100 hands for a term of five years; to insure the building for $15,000 and to rebuild it and continue in business in case it is destroyed. Between now and June 1 the establishment will be equipped with the most modern machinery and appliances for the manufacture of incandescent lamps. Manager J. B. Estabrook, of the Colonial Company, states that the combined output of the two merged factories will be greater than any other of the "independent" factories. The company claims that the main point that has served to bring its lamps into prominence is the excellent quality of the lamps running in voltage from 200 to 250. It is stated that most manufacturers do not undertake to make these; and that it is a reasonable argument which the customer well understands, that if a company can make a 220-volt lamp satisfactory to the trade, the lamps of lower voltage will surely be in the front rank. Cellulose filaments are used exclusively and the company has developed a filament of this character which is unusually tough and disintegrates very slowly even when burning at a high degree of incandescence. Mr. F. E. Kirschner, superintendent of the new company, has had ten years of experience in that capacity in prominent lamp factories in this country. Both Messrs. Estabrook and Kirschner will remove to Ravenna in the near future. It will be necessary to take forty or fifty skilled employees and heads of departments from the other factories; and the expectations are that when in full running order 200 hands will be employed. Ravenna is 35 miles from Cleveland, and about twice that distance from Pittsburg. It has three trunk lines of railway, the Erie, Pennsylvania and the B. & O., so that the shipping facilities are the best.

ACCUMULATOR BOX LININGS.—Street railway companies in this country and in Europe, which use the accumulator system in their cars, have been for several years trying to get a suitable method of lining their battery boxes which will be both durable as well as effective, the great difficulty being to obtain a lining not eaten away either by acids or heat. This has been a vexing proposition necessitating a large amount of study and experiment, and was a particularly serious matter for companies whose lines are equipped with the "mixed system," that is, accumulators for use within city limits and trolleys for the open country. Many of the methods recommended and tried yielded, when put to the test, either to the action of the acids or were rendered useless by the generation of the heat. During recent heavy snow storms in Berlin, one of the severest tests of the efficiency of any accumulator box, all of the street railways were crippled to a greater or less extent from burning out of boxes. Among these may be mentioned the Berlin-Charlottenburg street railway and also the street railway existing in Hanover, which companies had in use various styles of box linings for the purpose of ascertaining which was the best. It was found that the great majority of boxes were rendered useless, in some of them holes having been burned the size of a man's hand. The means of prevention which seems to have proved most efficient, however, was the P. & B. system, which remained intact, with the result that there is to be a general replacing of linings with that method, which consists of application of P. & B. paint, P. & B. ruberine, P. & B. junction box compound and P. & B. ruberoid, on many of the lines, among which may be mentioned the Grosse Berliner Strassenbahn Gesellschaft. The Standard Paint Co., who are the manufacturers of all of these products, are supplying the European market from their factory at Hamburg, and the P. & B. goods have taken high rank with all electrical and street railway companies, as in the United States.

SUPPLY PRICES.—For some time past agreements have existed among local groups of electrical supply dealers to maintain prices. These have once and again fallen through, and just lately an effort has been made at a meeting in this city to organize the work on a national basis, making prices practically uniform throughout the country. Another feature has been the deposit of $500 per member to ensure adherence to the compact, the infliction of a fine of that amount being the penalty for infraction of the agreement. As an offset to these movements, the electrical contractors who buy large quantities of such supplies have organized in various states, as in New York, where a strong society exists, and now the meeting in New York of the supply dealers is reported to have been promptly followed by antagonistic action of the contractors at Pittsburg, etc. It is to be hoped that unnecessary conflict will be avoided, as a ground of common interest ought to be found.

AMERICAN DREDGES ABROAD.—Some months ago we published an illustrated description of the Bates electrical dredge for heavy work, for which Mr. Lindon W. Bates, of Chicago, had received a $515,000 contract from the Russian government. The dredge is intended to remove obstructions and bars on the River Volga, the most important waterway in the empire. The dredge was built at Antwerp by the Société Cockerill, and the tests showed that the dredge could cut out and deposit ashore about 8400 cubic yards of dirt an hour. These tests have been satisfactorily repeated at St. Petersburg. In the meantime the government of Queensland, Australia, has contracted with Mr. Bates for similar apparatus to the tune of $1,250,000 and Calcutta has also ordered a Bates dredge. The three for Queensland will be 10,000-hp. The electrical apparatus for the Bates Russian dredge was furnished by the General Electric Company.

JANUARY EXPORTS AND IMPORTS.—The imports of merchandise for the month of January were valued at $75,826,475, which exceeds by $17,587,804 those for the same months last year. The exports of domestic merchanidse for January were $115,318,498, an increase of $1,462,608 over those for the same month last year. For the seven months ending January 31 the imports were valued at $486,402,905, an increase of $119,459,524, and the exports at $800,131,088, an increase of $50,534,973, over the like period of the previous fiscal year. The balance of trade in favor of the United States for the seven months was $313,728,183. As before, a large part of the gain in imports appears to consist of raw materials needed in the arts.

STANLEY ELEC. MFG. CO.—It is understood that all the steps for the transfer of this company to Roebling ownership have been completed, and a despatch from Pittsfield, Mass., is authority for the news that six new shops are to be added forthwith to the Stanley factories there, at a cost of $500,000. This, if true, would indicate an intention to push the excellent Stanley apparatus more vigorously than ever. It appears, however, to be an exaggerated local report, with probably some truth in it.

THE WARREN MANUFACTURING CO., of No. 32 Jackson street, Chicago, report shipment of their pulley cover to the country of the Boers; to the Monterey Electric Light Co., of Monterey, Mex., and to the Mexican plant of the Gates Iron Works, of Chicago, who have for some time been using the cover. The inquiries for this liquid pulley cover now come from all over the world.

CUTLER-HAMMER MFG. CO., of Milwaukee, Wis., the well known manufacturers of high-class rheostats, have increased their capital stock to $150,000 to take care of their large and growing business.

Special Correspondence.

ENGLISH NOTES.

London Office, Electrical World and Engineer, Feb. 17, 1900.

THE JOHN HOPKINSON MEMORIAL WING has been added to the University Engineering Laboratory at Cambridge by Lord Kelvin, on which occasion there was a great gathering of celebrated men. The Master of Trinity unveiled a portrait of Dr. Hopkinson, whose services to science in the university were of the most important character.

SWINTON AND PENDLEBURY DISTRICT COUNCIL have decided to adopt electric light, and will shortly call in an engineer for advisory purposes. The Electric Lighting Committee of the Council has visited several places where electric light has superseded gas for public lighting purposes, and are quite satisfied that their district should be equipped with a similar system. Mr. Charles Hopkinson, of Manchester, has recommended to have a continuous current system as being more suitable for the district, with a pressure of 400 volts, distributed by the regular three-wire system, so as to give the consumers the option of taking the current at 400 or 200 volts.

AT ST. HELENS LAKE an inquiry has been held into the application by the corporation for sanction to borrow £20,000 for an extension of electric lighting in the borough. The corporation obtained sanction to expend a sum of £10,000 and £16,000 in connection with the introduction and extension of electric lighting, and had overspent the amounts by nearly £3,000. They now propose to expend a further sum of about £17,000 in increasing their electric lighting plant and in extending their electric system to new districts of the borough. Up to the present the introduction of electric light has been an unbroken success. No one appeared to oppose the scheme.

MONEY FOR LIGHTING.—The local government board has decided to comply with the application of the Warrington Corporation for sanction to borrow £44,966 for the purpose of electric lighting, and £9,336 for the provision of a central depot at Parr Street. In connection with the last named, it is proposed to erect refuse destructors and utilize the heat in the raising of steam for driving the electric generators. At a recent meeting of the local electricity committee a letter was read from the Local Government Board referring to the application of the Bolton Corporation for sanction to borrow £100,000 for the purposes of electric lighting, and intimating that the department was willing to comply with the application so far as it related to the borrowing of £79,950, sanction being forwarded to a loan for that amount.

RUCKER VS. THE LONDON ELECTRIC SUPPLY CORPORATION is on again in the law courts, and is bringing out a mass of old testimony regarding alternating currents, transformers, the history of the adoption of transformers for electric lighting, the old Gaulard & Gibbs story, and a welter of material too much to wade through or write about. The ablest electrical engineers in Great Britain have appeared as witnesses, and the testimony has been of the most various kinds, and in many instances distinctly humorous. Mr. Swinburne's remark that "there was no state of knowledge, there was a very general state of ignorance," brought a smile from all present, and will probably be remembered for some time. Should the plaintiff win this case it would mean a monopoly of alternating current lighting, but there appears to be little chance of such a decision being given, as the mass of testimony is distinctly contrary to such a possibility. The testimony is now all in, the summations by opposing counsel have been made, and the judge has stated that he would take time to consider the evidence and give his judgment at a later date.

INGLETON, a village in the West Riding of Yorkshire, had a grand gala day recently, on the occasion of the opening ceremony of the electric lighting works. The growth of this village as a health resort had made the inconvenience from insufficient lighting very much felt. Nearly a year ago, therefore, contracts had been let for the erection of a generating plant, and the work had progressed satisfactorily from the first until the consummation was reached recently, when Mrs. Farrer, of Ingleborough Hall, preceded by the Ingleton brass band and all the local celebrities, gaily turned the switch which lit Ingleton electrically for the first time in its history. The plant is run by water power obtained from the River Greta, operating two turbines, each of which is geared to a dynamo, which has a maximum output of 35 amperes and 330 volts. Concentric cables have been used for the distribution, which is all underground, and these are covered and steel armored. Storage batteries are used, 116 in all, having a total capacity of 750 ampere hours. Drake & Gorham have been the contractors for all the electrical work, and the Callender Cable & Construction Company laid all the feeders and underground cables.

THE WAR'S SILVER LINING.—There is no cloud without its silvery lining, and the old adage is being rather forcibly brought to the minds of Englishmen at the present moment. It is the impression of many thinking men that when the unfortunate war which England is waging is all over a lasting benefit will have been derived, not in the ordinary commercial sense, but because it will have led Englishmen to see more clearly their own great deficiencies. Though England is agitated to its very centre at present by the news from South Africa, many are already hoping that the very suffering the country is experiencing will be the means to at last awaken England to a realization of its lack of scientific methods, not merely in its army equipments or its military attainments, but as to nearly all the sciences and arts. England to-day is not a scientific nation; it does nothing on scientific plans, and what attempt is made to advance like other nations is generally choked off by opposition. The newspapers and magazines criticize the lack of science shown in almost all branches of trade, and particular attention has been called by able writers to the backwardness of England in its electrical developments. Other countries are far more advanced in electric lighting, traction and telephone service. It is not because there are not good engineers in England, but on account of the stupid opposition that every engineering scheme encounters, and the mass of rules and regulations and "red tape" that have to be overcome, and the conditions imposed by Parliament. The English might truly be said to be their own worst enemies. The easy-going, self-satisfaction of Englishmen as to England and English methods has been the worst evil the country knows. It is getting a rude awakening now, however, and it is to be hoped that the lessons of the war will be taken to heart. There is still too much of the idea left that what was good enough for the forefathers is good enough for us. Some of our best manufacturers long ago opened their eyes to the fact that England does not "know it all," and have been for years freely purchasing machinery and tools from the United States and other progressive countries. Such manufacturers are successful, and are making progress, but many others, it is to be regretted, are still blind to the lessons to be learned, and will not adopt more modern and scientific methods. It is therefore on this account and for these reasons that it is hoped that after the war is all over and England has recovered its equilibrium, a careful analysis will be made of the whole condition of the economic principles governing in this country, and that the younger element will make the path easier for those who are willing and eager to introduce new and scientific methods of manufacture, of transport, or of lighting. It is a tremendous work to look forward to, but it will have to be done if England is to retain the leadership which she has enjoyed for so many years.

CANADIAN NOTES.

Ottawa, Ont., Feb. 24, 1900.

HAMILTON'S PROSPERITY.—The city of Hamilton, Ont., is enjoying a veritable boom at present, as a manufacturing centre. This is entirely owing to the cheap electric power furnished by the Cataract Power Company. Several large concerns, finding that they could secure electric power so cheaply in Hamilton, have located there and others are contemplating the advisability of doing likewise. About four years ago the idea of transmitting electrical energy to Hamilton from DeCew's Falls was first mooted and a company was formed and a charter secured to carry out the proposed undertaking. Instead of depending on the somewhat uncertain water supply at the falls it was proposed to secure a supply of water of a constant sort through a feeder from the Lake Erie level of the old Welland Canal at Allanburg. By placing the power house about three-quarters of a mile east of DeCew Falls an additional fall of 70 feet was obtainable, and at this point a private canal, 4¾ miles long, would bring a limitless supply of water from the Lake Erie level to the brow of the hill, where it could be held in storage basins. This plan was adopted. It was only after a considerable delay and much negotiation that a contract was made with a Dayton (Ohio) company for the water wheels required, the hydraulic development, desired by the company, presenting obstacles which, owing to the large units and high head, made it difficult to secure a builder who would give what the hydraulic engineer's specifications called for. The turbines finally secured were of a special horizontal pattern, guaranteed to work under a head of 265 feet and at a speed of 400 revolutions per minute, each being of 2000-hp. Then the company had next to face the problem of generating and transmitting the power over such a long distance to Hamilton—35 miles. What is now known to be an easy thing in the long distance transmission was at that time a seemingly insurmountable difficulty. The highest working pressure up to that time was not above 10,000 volts, and at that pressure the cost of a transmission line was too great for the company to consider. To transmit over the long distance it was necessary that the pressure be 20,000 volts or over. For nearly a year this trouble presented itself to oppose the progress of the enterprise. Finally, Mr. J. A. Kammerer, of the Royal Electric Company, Montreal, was called in, and, after he had carefully considered the whole scheme, his company agreed to undertake the work which, with its consequent saving with a working pressure of 24,000 volts guaranteed, brought the cost within the limits deemed necessary. The Cataract Company at the present time controls the Hamilton street railway system, the Hamilton & Dundas Electric Railway, the Hamilton Radial Railway and is now taking steps to build an electric line from Hamilton to Guelph and Galt. Another line that is contemplated is one to Niagara Falls. The company's business, also, in the supplying of electric power for factory purposes is increasing to a marvelous extent, and at the present time it has contracts with companies about to start business in Hamilton amounting to more than the total amount already sold.

General News.

THE TELEPHONE.

OCEAN SPRINGS, MISS.—A telephone exchange has been formed in this city.

CLEAR LAKE, MINN.—A telephone system is to be established here during this year.

DETROIT, MICH.—The Kibbie Telephone Company, of Kibbie, has increased its capital $15,000.

BATTLE CREEK, MICH.—The Bell Telephone Company contemplates building a new exchange here.

BURR, MINN.—It is proposed to establish a telephone system in this place, Gary and other places hereabouts.

HOBART, IND.—The Northwestern Indiana Telephone Company has completed its local exchange in this town.

NEW ORLEANS, LA.—An ordinance has been introduced in the city council to regulate telephone charges in this city.

PARIS, IDAHO.—A franchise has been granted to the Rocky Mountain Bell Telephone by the city council of this place.

OSHKOSH, WIS.—The Northwestern Telephone Company of this place has been absorbed by the Wisconsin Telephone Company.

MILWAUKEE, WIS.—A telephone line is projected between Fort Atkinson, Wis., and Cambridge, Wis. The distance is about 12 miles.

TOLEDO, OHIO.—The New Harrison Telephone Company gave a trust deed to the Security Trust Company to cover issue of $100,000 in bonds.

PONTIAC, MICH.—The contract for erecting the Michigan Telephone Company's new exchange in this city was awarded to W. A. Peck for about $4500.

NASHVILLE, IND.—The Edingburg telephone line, which is being extended southwest through the county by the farmers along the line, will be extended to this city.

ST. PAUL, MINN.—A mortgage for $65,000 has been given by the Mississippi Valley Telephone Company to John E. Andrus, of New York, to insure the payment of a note.

DARRTOWN, OHIO.—The Darrtown Telephone Company, of Darrtown, has applied for a franchise. The application is signed by President Frank S. Buffer and John F. Mee, secretary.

JUNCTION CITY, KAN.—The Independent Telephone Company has been granted a 20-year franchise. The rates are to be $2 per month for business and $1 per month for residences.

LANSING, MICH.—The Independent Telephone Exchange of this city has been transferred to the Grand Rapids Citizens' Telephone Company, the leading independent company of the state.

OAKLAND, CAL.—The Sunset Telephone & Telegraph Company has given a mortgage to the Old Colony Trust Company, of Massachusetts, for $2,500,000, to secure bonds to an equal amount.

BUFFALO, N. Y.—The post office building in this city is to be fitted out with a private telephone exchange connecting the various departments of the service with the regular Bell service.

DES MOINES, IOWA.—The Indianola Mutual Telephone Company, of Indianola, has been incorporated. Capital, $20,000. Incorporators, J. F. Hendricks, E. B. Donell, both of Indianola.

ELGIN, MINN.—The Elgin Telephone Company has been incorporated. Capital, $25,000. Incorporators, W. T. Adams, Nellie G. Adams, G. A. Hallenbeck, W. P. Holton, R. Williams, all of Elgin.

MUSKEGON, MICH.—It is stated that the Michigan Telephone Company will erect in this city a new exchange, with a capacity of 2000 subscribers, at a cost of $80,000 for building and equipment.

NORTH VERNON, IND.—The North Vernon Telephone Company has been incorporated. Capital, $10,000. Incorporators, C. Wright, S. L. Wright, C. B. Wright, I. E. Wright, all of Paris Crossing.

EVANSVILLE, IND.—Minneapolis capitalists, headed by H. K. Cole, have purchased the Evansville District Telegraph Company's plant with a view of putting in an independent plant for telephones.

IOWA FALLS, IOWA.—The Hawkeye Telephone Company has been incorporated here. Capital, $40,000. Incorporators, O. Wettstein, Jr., F. E. Wettstein, S. Wettstein, F. W. Brown, C. A. Bloron, all of Iowa Falls.

CONNERSVILLE, IND.—The Connersville Telephone Company has been incorporated. Capital, $25,000. Incorporators, E. M. Anstead, W. H. Rothchilds, L. W. Frazier, W. T. Edwards, all of Connersville.

NORTH VERNON, IND.—William N. and Emma B. Turner, who own the telephone system in this city, have sold their investment to Charles & Samuel L. Wright for $15,000 cash. The Wrights will form a corporation.

NASHVILLE, TENN.—The Stantonville Telephone Company, of McNairy County, was granted a charter. Capital stock, $1000. The incorporators are J. R. Hurley, L. A. Lackman, N. A. Erwin, J. R. Gooch and James Jenkins.

UTICA, N. Y.—At the annual meeting of the Central New York Telephone & Telegraph Company officers were elected as follows: President, L. H. Lawrence; secretary and treasurer, F. G. Wood; general manager, C. A. Nicholson.

KANSAS CITY, MO.—At a meeting of the board of directors of the Missouri & Kansas Telephone Company John R. Mulvane, of Topeka, was re-elected president and Edward Wilder, of the same city, was re-elected secretary.

GLOVERSVILLE, N. Y.—The common council has granted a conduit franchise to the Hudson River Telephone Company for its wires. The Glen Telephone Company has been granted a franchise, and will pay the city $500 for the same.

LA CROSSE, WIS.—Joint action has been taken by all telephone and telegraph companies doing business in La Crosse, five all told, agreeing to place all wires in business districts of the city and on principal residence streets underground this year.

COCHECTON, N. Y.—The Delaware Valley & Lake Huntington Telephone Company has been incorporated. Capital, $2000. Incorporators, J. Cornwall, of Cochecton; J. Bennedure, Jr., W. F. Henry, G. Henry, W. J. Bennedure, Jr., all of Lake Huntington.

OTTAWA, ONT.—The Dominion Government has decided to proceed at once with the construction of the telephone line from Atlin to Quesnelle, British Columbia, to connect with the eastern telegraph system, so that messages can be sent direct by wire to Dawson.

RAVENNA, OHIO.—The Central Union Telephone Company is preparing to improve its exchange here. A new switchboard on the common battery system will be installed. The rates will be reduced to $18 for business and $12 for residences, and for long distance telephones, $36 and $24.

JACKSONVILLE, FLA.—The exchange of the Jacksonville Telephone Company is regarded as one of the finest in the south. At the recent annual meeting a statement showed the receipts last year to have been $16,163.43 as against $12,966.29 in 1898. The company has 786 instruments in use.

MILWAUKEE, WIS.—The Midland Telegraph Company was incorporated on Feb. 19 by Alex. McD. Young, George Knowles and M. P. Addis, of this city. The new company will make improvements in the lines and the service to make them more serviceable to the Milwaukee board of trade.

DENVER, COLO.—The Rocky Mountain Bell Telephone Company has secured a franchise from Montpelier municipality. The company will build from a point in Cache Valley over into the Bear River Valley and connect Paris also, and prominent adjacent points in the upper Bear Lake Valley.

CIRCLEVILLE, OHIO.—The Citizens' Telephone Company has applied for a franchise. The new company agrees to furnish telephones for $24 per year for business and $12 for residences, on individual lines, and will furnish the city one telephone for each hundred subscribers, free of charge.

NEW YORK, N. Y.—At the annual meeting of the Chesapeake & Potomac Telephone Company on Feb. 23, the following named directors were elected: Jeremiah M. Wilson, Arthur G. Fuller, John E. Hudson, Charles J. Bell, Horace S. Cummings, Henry A. Willard, C. Jay French, John H. Cahill, Joseph P. Davis.

TERRE HAUTE, IND.—Local capitalists are organizing a new telephone company and propose building a new plant, work to begin March 1. The rates promised to be charged are $18 and $30 per year for residences and business houses, respectively. It is proposed to put the greater part of the line underground.

ONAWA, IOWA.—The Iowa Telephone Company has applied to the Onawa town council for a 20 years' franchise to put in a local telephone exchange with rates of $18 for residences and $24 for business houses per annum. The council will likely submit the question to the voters of the town at the regular March election.

NEW YORK, N. Y.—At a meeting of the Delaware & Atlantic Telegraph & Telephone Company, held here on Feb. 13, the following named gentlemen were elected directors: Thos. T. Eckert, Jas. Merrihew, John H. Cahill, Thos. Sherwin, H. S. Huidekoper, J. E. Mitchell, J. M. Brown, John E. Hudson, G. W. E. Atkins.

SIOUX CITY, IOWA.—Through the purchase of the system and lines of the Home Telephone Company, with headquarters at Sioux City, the Nebraska Telephone Company has come into possession of the Sioux City exchange, 300 miles of toll lines, besides numerous small exchanges scattered throughout western Iowa and South Dakota.

MONTREAL, QUE.—The Bell Telephone Company has just opened a long distance copper metallic circuit line between Ottawa, Carleton Place, Smith's Falls, and Brockville, Ont. It required upward of 3500 poles, 4000 cross arms and 75,000 pounds of copper wire. This line gives Ottawa a direct long distance service with Buffalo, N. Y., and other western points.

ALBANY, N. Y.—A bill has been introduced in the legislature to prevent the erection of telephone, telegraph or electric light poles in cities of 50,000 inhabitants or over, except such as are necessary in connection with an underground system of wires. Independent telephone men, it is stated, regard this as an effort to stifle competition. They will fight the bill.

BUFFALO, N. Y.—Stockholders of the Bell Telephone Company have voted to increase the capital stock from $2,000,000 to $5,000,000. This increase in stock is said to be necessary on account of the large amount of money required for new construction work that has been planned. A contract has been awarded the Western Electric Company to equip the Buffalo service with the latest improved apparatus.

DUBUQUE, IOWA.—At the annual meeting of the Tri-City Telephone Company the following officers were elected for the ensuing year: S. W. Gardiner, president; H. S. Towle, vice-president; Artemus Lamb, treasurer; S. W. Towle, secretary. It is the intention of the company to greatly improve its system and the construction of toll lines to Davenport, Cedar Rapids, Dubuque and other points is contemplated.

PHILADELPHIA, PA.—An ordinance has been proposed in the city councils which practically repeals all telephone ordinances except that of the Bell. Six companies are affected, as follows: Baxter Overland Telephone & Telegraph Company, Clay Commercial Telephone Company, Mutual Automatic Telephone Company, People's Telephone Company, Drawbaugh Telephone & Telegraph Company, Philadelphia Standard Telephone Company.

BOSTON, MASS.—It is stated that the forthcoming annual report of the Mexican Telephone Co. will show business has made a gradual but very satisfactory extension during the past year. An amount nearly equal to that expended during the year 1898, about $50,000, has been put into new construction work and paid out of the earnings of the company. The company will show, altogether, this year, a gain of over 200 subscribers, and, after it has paid for all its construction and operating expenses, it will have a cash surplus on hand.

TERRE HAUTE, IND.—The Independent Telephone Companies of eastern Illinois and western Indiana held a meeting in this place on Feb. 13, for the purpose of forming a permanent organization. Charles R. Duffin, of Terre Haute, was elected president. A committee was appointed to arrange a working agreement. Ten Illinois towns and nine Indiana towns had representatives at the meeting. Dr. Lumpkins, of Illinois, president of the Illinois Independent Telephone Association and vice-president of the National Independent Telephone Association, was present.

MILWAUKEE, WIS.—The Union Telephone Company, which controls the city telephone lines in Richland, Grant, Crawford and Iowa counties, has made a proposition to the various farmers' lines in the counties to have the latter lines connect with the central stations of the Union Company. The proposition does not contemplate a consolidation of the various interests, but rather an arrangement by which the patrons of the farmers' lines will be given the benefit of the city exchanges and the subscribers of the Union Company be accorded a more convenient means of reaching the patrons of the farmers' lines.

ROME, N. Y.—The Constableville & West Leyden Telephone Company has asked for a franchise here. Its rates will not exceed $25 per year for business purposes, $15 for private residences, and $10 for party line service in the resident portion, limited to six, within two miles of the central station, and $1 per year in addition beyond the two-mile limit for each mile beyond the two miles, rents to be collected quarterly in advance. The company asks the privilege to combine or consolidate or assign its rights to the Black River Telephone Company. The city is to have 12 telephones free, and the franchise is for 25 years.

MINNEAPOLIS, MINN.—The trouble which has existed for some weeks between the Minneapolis druggists and the Northwestern Telephone Exchange Company has finally been adjusted. The telephone company objected to the general public's using the telephones of the druggists. It is now agreed that the instruments which were taken out during the trouble will be returned and a pay station (nickel-in-the-slot) telephone will be placed in all drug stores not

already provided, in addition to the regulation instrument. It will be left to the general public which telephone it shall use, thus relieving the druggists of all responsibility.

COLUMBUS, OHIO.—A bill has been introduced in the house of representatives providing that telephone companies shall not charge more than 3 mills per mile for telephone messages where the distance exceeds 30 miles and not more than 5 mills per mile under 30 miles. In cities of the first grade, the charges for telephone service must not exceed the following rates: For full metallic circuit, $4 per month for business and $3 per month for residences; for common circuit, $3 and $2; for party line, $2 and $1. In other cities the rates must not exceed $3 and $1.50; $2 and $1, and $2 and $1 for the same services. Companies violating the law are to have their charters revoked.

CHICAGO, ILL.—J. M. Thomas, of Chillicothe, Ohio, president of the Independent Telephone Association of the United States, was here recently, in consultation with Hugh Doherty, of the Independent Telephone Company, and others interested in the Telephone, Telegraph & Cable Company of America. Mr. Thomas said that the New York company will build as far west as Cleveland, where it will connect with the western lines. The Kinloch Company, of St. Louis; the Illinois Telephone & Telegraph Company, of Chicago, and practically all the independent telephone companies of the west will, he said, become a part of the Independent Telephone Association of the United States.

ELECTRIC LIGHT AND POWER.

CLEAR LAKE, MINN.—An electric light system is proposed for this place this season.

BARABOO, WIS.—The Prairie du Lac electric light plant has been destroyed by fire.

RALEIGH, N. C.—Bids are asked for the establishment of an electric light plant at the penitentiary.

LONG PRAIRIE, MINN.—The village council has concluded to purchase the electric light plant for $10,000.

DURHAM, N. C.—The electric light plant at this place was demolished by the explosion of a boiler on Feb. 12.

BANDON, ORE.—The Bandon Light & Water Company, of Bandon, Ore., recently increased its capital stock to $7000.

YARDLEY, PA.—The People's Electric Light Company, of Yardley, has sold its plant to a party of Trenton capitalists.

MADISON, WIS.—Extensive improvements will be made on the electric light plant, which will cost approximately $8000.

NEW WILMINGTON, PA.—The voters of this place have authorized the issue of $6000 worth of bonds for erecting an electric light plant.

PERKASIE, PA.—The Perkasie electric light plant, which is owned by the borough, has been put in operation. It was erected at a cost of 15,000.

SPRINGFIELD, OHIO.—A commission is to be appointed by the council to investigate the subject of a municipal electric light plant for this city.

SHAMOKIN, PA.—Plans are being formulated by the Shamokin Light, Heat & Power Company for the erection of a plant to displace the two now in operation.

COLUMBUS, OHIO.—It is stated that there is no likelihood of a consolidation between the Columbus Edison Electric Light Company and the Columbus Gas Light & Heating Company.

SCOTLAND, S. D.—The authorities of Scotland, S. D., have decided to light the town by electricity and the preliminary steps have been taken to build an electric lighting plant.

PLATTEVILLE, WIS.—The Platteville Electric Light Company has contracted with the General Electric Company to put in the alternating constant current arc lighting system for street lighting.

OWOSSO, MICH.—The Corunna electric lighting plant has changed ownership, C. W. Holley, retiring. George Clutterbuck takes as partners A. S. Hatch, of Detroit, and H. W. Norton, of Holly.

ROCHESTER, N. Y.—The plant of the Genesee Paper Company on the west bank of the river has been purchased by the Rochester Gas & Electric Company, and will be converted into a power station.

TRENTON, N. J.—The South Jersey Water & Electric Power Company, of Vineland, has been incorporated with a capital of $250,000. Incorporators, C. K. Landis, Matilda T. Landis, M. Fry, all of Vineland.

CLEVELAND, OHIO.—An electric lighting and power plant will be required for a new five-story hotel to be built in Cleveland. A. E. Sprackling, 204 Superior Street, of this city, is preparing the specifications.

PHILADELPHIA, PA.—A resolution has been introduced in councils asking for an appropriation of $250,000 to establish a municipal electric light plant on the property formerly occupied by the Ninth Ward gas works.

WALKERTON, ONT.—W. A. McLean, D. Robertson, N. Robertson, John Rowland and W. E. Butler, and others, have been incorporated as the Walkerton Electric Light & Power Company, Limited, with a capital of $30,000.

WILLIAMSON, W. VA.—Williamson Electric Light, Power & Water Company has been incorporated. Capital, $50,000. Incorporators, C. H. Jones, Lula F. Garner, T. B. Garner, J. A. Sheppard, W. G. Koontz, all of Williamson.

RAYNE, LA.—A project is on foot by the business men of Rayne to erect an electric light plant and waterworks for the town. Dr. R. C. Webb and A. S. Chappius are a committee to bring about these much-needed improvements.

DULUTH, MINN.—The Black River Falls Company, of Douglas County, Wis., has been organized to develop the water power at Black River Falls, generate electricity and sell the same for power in Douglas County and St. Louis County, Minn.

ALBANY, N. Y.—The Lockport & Newfane Power & Water Supply Company, with a capital of $500,000, has petitioned for incorporation. Williard D. Ransom, Henry I. Pierce, John A. Merritt and Harry L. Ransom are named as incorporators.

MADISON, S. D.—The patronage of the electric light plant at Madison has increased to such an extent as to require an enlargement of the plant to double its present capacity. It is estimated that the improvements will entail an expense of at least $8000.

DETROIT, MICH.—The Bay County Electric Light Company's plant at Bay City has been sold to Bertram & Storrs, of New York; consideration, $100,000. The company is preparing to build a new power house and make other improvements to its plant.

TOMS RIVER, N. J.—The Toms River & Island Heights Electric Light & Power Company, recently incorporated, is in the market for equipment. A. A. Brant is president; S. R. Applegate, vice-president; G. H. Holman, secretary, and H. A. Low, treasurer.

NEW ALBANY, IND.—The Jeffersonville Light & Water Company, at Jeffersonville, has mortgaged its plant and franchises to the American Trust & Savings Bank, of Chicago, to guarantee the payment of $58,000. The plant when completed will be operated by the city.

MONTREAL, QUE.—The Shawinigan Water & Power Company, of Montreal, is advertising that it will be prepared to deliver electrical power at Shawinigan Falls, Que., in the early part of next summer. Contracts have already been made covering the use of over 20,000 horse power.

CLAYTON, N. Y.—The St. Lawrence International Electric Company, of Alexandria and Clayton, has been incorporated, with a capital of $20,000. Directors, F. L. Hall, Clayton; W. E. Miller, William W. Avery, J. S. Keeler, William Leyare, A. A. Leyare and N. A. Haughton, Alexandria Bay.

CHARLESTON, ILL.—The Charleston Thomson-Houston Electric Company will increase its capital stock from $40,000 to $80,000 in order to increase the scope of the business by adding a central heating plant. The company is also considering the advisability of putting in a new system of street lights.

STATESVILLE, N. C.—The electric light department of Statesville, N. C., will add one 60-kw alternator, one 100-hp boiler and one 150-hp engine. They will receive bids on the above with station equipment. Address D. A. Miller, chairman of Electric Light Committee, or Electric Light Department, Statesville, N. C.

HARPER'S FERRY, W. VA.—The Harper's Ferry Electric Light Company has begun to issue stock and petition adjacent counties for the right to place poles along the highway. The company will use the waters of the Shenandoah and Potomac and transmit power to Charlestown, Sheperdstown, Martinsburg and Winchester.

BENNINGTON, VT.—Referee George R. Donnan sold the Hoosick Falls Water, Power & Light Company's plant at foreclosure sale for $20,000 to C. F. Weed, of Boston, who represented the bondholders. The mortgagee is the Old Colony Trust Company, of Boston, and the mortgage amounts to $150,000. The plant is estimated to be worth $100,000.

ELKADER, IOWA.—The citizens of Elkader, Iowa, voted on Tuesday, Feb. 13, to grant a franchise for an electric light and power plant to Messrs. Schmidt Bros. & Co., of that city. The power will be furnished by turbine wheels, together with a reserve steam plant. Mr. H. L. Griffith, of Elkader, Iowa, is acting as consulting engineer and will prepare the specifications.

SAN FRANCISCO, CAL.—The Pelton Water Wheel Company, of San Francisco, recently shipped four impulse wheels to the Snoqualmie Falls Power Company's transmission plant, which supplies lights in Seattle, Wash. They will be installed to drive the third generator in the station and have an aggregate capacity of 1200-hp.

JOPLIN, MO.—The city of Joplin's right to furnish electric light for commercial purposes was decided by the Circuit Court, Feb. 20, in favor of the city. The Southwest Missouri Electric Light Company's effort to restrain the city from furnishing lights to the public proved futile. The case will probably go to the Court of Appeals.

LOCKPORT, N. Y.—The Lockport & Newfane Power & Water Supply Company will build a dam for electric power development. The dam will be 50 feet high and 2500-hp will be obtained. The electric power will be used for railway and other purposes. Construction work will begin about April 1. No contracts have yet been made. Mr. W. T. Ransom is at the head of the company.

ST. LOUIS, MO.—The contract to furnish electric light in downtown sections of the city, after Sept. 1, on which H. R. Budd, of Bunker Hill, Ill., was the lowest bidder, will be awarded to the Imperial Electric Light, Heat & Power Company if the city counselor pronounces it legal to make the award. The board is not satisfied with Budd's bid, and the Imperial is the next lowest bidder.

SIDELL, ILL.—The Sidell Electric Light, Cold Storage & Ice Company, which was recently organized here, is ready to purchase equipment. The company is in the market for boilers, engines, dynamos, wire, etc., besides insulating paper and other material for the cold storage house. Mr. H. J. Sconce is president; H. C. Holton, vice-president, and J. H. Herron, secretary and treasurer.

PERU, IND.—The report to the city council by the special committee sent out to visit the leading cities of the state with a view to purchasing the old or erecting a new electric light plant, to be owned and operated by the city, was favorable to the scheme. As a result Messrs. Ulen & Parrott, of Indianapolis, have agreed to build the plant on such terms as will enable the city to own it at the expiration of 10 years.

PITTSBURG, PA.—The Southern Light, Heat & Power Company has filed a mortgage for $300,000 to guarantee the issuance of bonds for big extensions south of the Monongahela and the Ohio rivers. The company is aiming at the project of furnishing electric light and power throughout Allegheny County

outside of the city of Pittsburg, and a number of the smaller local electric plants have been absorbed by it for this purpose.

HEALDSBURG, CAL.—The Healdsburg municipal electric lighting plant was recently put into operation. The Stanley Electric Manufacturing Company installed the entire lighting system. There is a 150-kw Stanley generator connected to a Pelton water wheel operated under a 1100-foot head of water. Both the transmission line and the distributing conductors are of aluminum wire, supplied through the Stanley Company's San Francisco agents.

OCONOMOWOC, WIS.—The financial statement of the operation of the local electric light plant up to Feb. 1, under municipal management, is highly satisfactory to the officers of the city government. The period covered by the statement is for seven months, from July 1, 1899, at which date the city took possession of the plant. During that time there has been an increase of between 300 and 400 in the number of lights supplied to individuals, and the price of lights has been reduced.

LEXINGTON, VA.—The stockholders of the Lexington, Va., Light & Power Company elected the following directors: Messrs. L. H. Latham, Louis Duncan, John C. Powell and William G. Wetherall, of Baltimore; Robert E. Hutton and D. C. Humphreys, of Lexington. The board re-elected Mr. L. H. Latham, of Baltimore, president; Mr. D. C. Humphreys, of Lexington, vice-president, and Mr. Robert E. Hutton, of Lexington, secretary and treasurer. The stock of the Lexington Light & Power Company is largely held in Baltimore.

LOS ANGELES, CAL.—The United Electric, Gas & Power Company was recently incorporated, with Los Angeles, Cal., as the principal place of business. Directors, H. V. Carter, G. I. Cochran, Los Angeles; F. H. Rindge and J. J. Davis, Santa Monica, and A. Stedman, Monrovia. Capital stock, $650,000. The main generating station will be located in Santa Monica, and the present electric lighting plant in that city will be considerably enlarged to supply the consolidated electric systems. Charles C. Moore & Co., San Francisco, will supply the additional steam plant to be installed. Babcock & Wilcox boilers are included in the contracts.

OTTAWA, ONT.—The owners of the Burleigh Falls power, near Peterboro, Ont., have applied for incorporation, with a capital stock of $750,000, for the purposes of developing the water powers and transmitting electrical energy to the towns of Peterboro, Lakefield and Lindsay and surrounding district, and for an electrical railway business in the vicinity. The following gentlemen are the petitioners for incorporation, and will act as directors: Hon. Senator McLaren, Perth; Hon. R. Harcourt, Toronto; Eugene Coste, Mayor James Kendry, Peterboro; J. A. Culverwell, Toronto, electrical engineer and managing owner of Burleigh Falls power, and five other prominent persons. A minimum of 5000-hp is available, and some 2000-hp will be developed at the commencement.

CINCINNATI, OHIO.—At the annual meeting of the Cincinnati Edison Electric Company George R. Sheldon, C. W. Wetmore, C. R. Spofford, A. Marcus and William N. Cromwell, all of New York, and George Bullock, Maurice J. Freiberg, James J. Hooker, J. B. Foraker and W. F. White, of Cincinnati, were elected directors. Mr. Bullock was re-elected president, Mr. Wetmore, vice-president, and Mr. White, general manager. The contract for the storage battery, which is to be located in the cellar of the new Fifth Street building, was awarded to the Electric Storage Battery Company, of Philadelphia, at its bid of $10,000. Contracts for the generators, amounting to $78,000, were let to the General Electric Company, and for the engines, amounting to $10,000, to the E. P. Allis Company, of Milwaukee. Wires in the territory bounded by Third Street, Broadway, the canal and Central Avenue will be placed underground at a further cost of $10,000.

THE ELECTRIC RAILWAY.

FLORA, IND.—The Ohio Trust Company, of Columbus, will build an electric road from Marion to Delphi.

ALBANY, N. Y.—The Albany & Hudson Railway & Power Company has filed a certificate of extensions of route.

WINSTON, N. C.—J. G. White & Co., of New York, have the contract for the extension of the street railway here.

KANSAS CITY, MO.—The Home Electric Street Railway Company has applied to the council for a franchise here.

XENIA, OHIO.—The Columbus & Xenia Traction Company has been incorporated with a capital stock of $10,000.

HARRISBURG, PA.—The Nunnery Hill Street Railway Company has been incorporated with a capital stock of $24,000.

MILLTOWN, N. J.—The Brunswick Traction Company's car sheds at this place were destroyed by fire recently. Loss, $40,000.

REYNOLDSVILLE, PA.—The Reynoldsville Traction Company will hereafter be known as the North Pennsylvania Traction Company.

MILLVILLE, N. J.—The Bridgeton & Millville Traction Company is connecting its feeders with the trolley wires with aluminum wire.

SEATTLE, WASH.—The equity court has restrained the city and promoters of the Consolidated Street Railway from ratifying the franchise.

BOSTON, MASS.—The railroad commissioners have approved the issue of $45,000 of mortgage bonds by the East Taunton Street Railway Company.

WASHINGTON, D. C.—The house district committee has favorably reported the bill to authorize the Capital Traction Company to extend its tracks.

PORTLAND, ORE.—The Portland Traction Company has petitioned the council for the right to build a new line to connect with its present system.

ALBANY, N. Y.—The state board of railroad commissioners have approved of the mortgage of $200,000 issued by the Rome City Street Railway Company.

AKRON, OHIO.—The stockholders of the Northern Ohio Traction Company have decided to extend their line from this city to Barberton, seven miles.

CHATTANOOGA, TENN.—The stockholders of the Chattanooga Electric Railway held a meeting here on Feb. 8 to provide for extensions of the system.

ST. LOUIS, MO.—A bill was introduced in the City Council Feb. 16, providing for reduced street car fare for passengers who are not provided with seats.

DULUTH, MINN.—Thomas Lowry, of Minneapolis, has purchased the Lakeside Street Railway Company, of this city, and is now in control of the company.

BUFFALO, N. Y.—The Buffalo & Niagara Falls Electric Railway Company is rapidly dismantling the big power house on Sweeney Street, in Tonawanda, N. Y.

HUBBARD, OHIO.—Council has granted a franchise to the Youngstown & Sharon Street Railway Company, giving the right of way over certain streets in the town.

TAMAQUA, PA.—The borough council of this place agreed to give the Schuylkill Valley Electric Street Railway right of way over certain streets of Tamaqua.

FORT WAYNE, IND.—The Ohio & Indiana Traction Company has secured a franchise for the building of an electric line from Fort Wayne, Ind., to Hicksville, Ohio.

HUBBARD, OHIO.—Council has granted a franchise to the Youngstown & Sharon Street Railway Company, giving the right of way over certain streets in the town.

MT. HOLLY, N. J.—The Moorestown Trolley Company has been incorporated to build an electric railway from Merchantville to Moorestown and thence to Mt. Holly.

OSGOOD, IND.—Active steps are being taken to build an electric line from here to Versailles, the county seat, a distance of five miles. Grant Johnson is the promoter.

INDIANAPOLIS, IND.—The Indianapolis & Mt. Nebo Interurban Electric Railway Company has been organized in this city. J. Q. Justice is the leading promoter.

ALTON, N. Y.—A petition will be presented to the Rochester & Sodus Point Electric Railroad to continue the road from Wallington to Sodus Point by way of this place.

NEW BRUNSWICK, N. J.—The Elizabeth & Westfield Electric Railway Company has purchased the Union & Middlesex Railway Company's seven-mile line to Boynton Beach.

WATKINS, N. Y.—A franchise has been granted to Burdette and Charles W. Hathaway to build an electric railway. The Hathaways, it is stated, represent New York parties.

DOVER, DEL.—The Delaware General Electric Railway Company has awarded to McGlathery, Stone & Co., of Philadelphia, the contract for the construction of the railway.

OIL CITY, PA.—The traction companies of Oil City and Franklin, Venango County, have pooled their interests, and the two cities are to be connected by trolley lines costing $350,000.

TOLEDO, OHIO.—J. M. & C. W. Ryan, of Toledo, have bought the entire property of the Put-in-Bay water works, light plant and railway at special master's sale, paying therefor $16,501.

COLUMBUS, OHIO.—The Columbus & Xenia Traction Company has been incorporated by John Little, A. Wikersham, A. G. Carpenter, F. E. McGeney and A. S. Frazer. Capital, $10,000.

COLUMBIA, S. C.—A. M. Guignard has secured the contract for the extensions of the Columbia Railway & Power Company's trolley system, including the portion of the line to be rebuilt.

RICHMOND, IND.—Henry B. Pruden, of Dayton, Ohio, has asked for a franchise over the National road to Eaton for an electric railway. Two companies are now seeking the franchise.

WOODSIDE, L. I.—Engineers of the New York & Queens County Railroad Company have commenced surveying the line of the proposed Jackson Avenue extension from Woodside to Flushing.

NIAGARA FALLS, ONT.—The Lincoln county council has passed a by-law granting to the Queenstown, St. Catharines & Port Dalhousie Railroad the right of way over the public highways.

FRANKLIN, PA.—The trolley line from DuBois to Franklin will take in DuBois, Reynoldsville, Brookville, Corsica, Strattonville, Clarion, Shippensville, East Sandy, Oil City and Franklin.

MARION, N. J.—The Marion Transit Company has petitioned the city council for a franchise to the city limits. The company proposes to build several suburban lines, with Marion as the centre.

WASHINGTON, D. C.—The district commissioners have approved the plans of the Capital Traction Company to build its proposed extensions in the city limits. D. S. Carll is engineer of the company.

DUNKIRK, N. Y.—The Dunkirk & Hickoryhurst Traction Company, the successors of the Dunkirk & Hickoryhurst Electric Railroad Company, has made an application for a street railroad franchise.

PHILADELPHIA, PA.—The Schuylkill Valley Traction Company, whose lines were recently purchased by the United Power & Transportation Company, has formally passed into the hands of the latter.

INDIANAPOLIS, IND.—An electric railway to start from the State Fair grounds to Mt. Nebo has been projected, and a company already organized to build the road. A private right of way is being secured.

BOSTON, MASS.—Clark & Mills, of this city, have closed a large contract to do the wiring in the Boston & Albany coal pockets at East Boston. Messrs. Clark & Mills do most of the electrical work for this road.

LOGANSPORT, IND.—President J. T. McNary and Engineer Ray, of the Logansport, Rochester & Northern Traction Company, have gone to select a site for the power house between this city and Kendallville.

WAREHAM, MASS.—The selectmen have granted a franchise to the Middleboro, Wareham and Buzzards Bay Street Railway Company to locate its tracks from the Onset Junction and thence to Point Independence.

PITTSBURG, PA.—The Monongahela Electric Street Railway Company has awarded a contract to the Pittsburg Bridge Company for an extension to the Rankin Bridge over the Monongahela, which will cost $30,000.

RICHMOND, VA.—The stockholders of the Richmond, Passenger & Power Company have effected a temporary organization. Maj. James D. Patton was elected president, and Mr. D. A. Ainslie, secretary and treasurer.

BALTIMORE, MD.—The Maryland Electric Railway Company has asked for a franchise to build an electric line in the city and suburbs. Messrs. I. L. Straus and Arthur P. Gorman, Jr., are counsel for the company.

SHARON, PA.—The Sharon & Youngstown Street Railway Company, which is building a line from Youngstown to Sharon, Pa., has secured an option on the Sharon Springs Railway, also an option on the plant of the Shenango Valley Electric Light Company, in this city.

CLEVELAND, OHIO.—The directors and stockholders of the Cincinnati & Hamilton Traction Company and the Cincinnati & Miami Valley Traction Company have perfected arrangements for the consolidation of the two roads.

DES MOINES, IOWA.—It is reported here that the General Electric Company is negotiating for the control of the Des Moines City Railway Company. The General Electric has a monopoly of the electric privileges in this city.

HUNTINGTON, IND.—The Commissioners of this county have granted a franchise to the Ohio & Indiana Traction Company, organized to build an electric road from Hicksville, Ohio, to Marion, via Ft. Wayne and Huntington.

APPLETON, WIS.—Appleton and Kaukauna are to be connected by an interurban electric line. A franchise is to be passed at the next Kaukauna council meeting, and according to its terms the road will be in operation by next summer.

ALBANY, N. Y.—The Stillwater & Mechanicville Street Railway Company proposes to build several extensions through the streets of the village of Waterford and will make a new connection with the lines of the United Traction Company.

DELPHI, IND.—A new electric line has been projected to run from this city to Burlington, a distance of 22 miles. At Burlington it will connect with the proposed Logansport & Indianapolis line. Burlington is without railway facilities.

TAUNTON, MASS.—The Taunton, Norton & Easton Street Railway Company has been organized with a capital of $140,000. The road will be 14 miles long. F. Mead, of Norton; George Hatch, of Taunton, and A. M. Clement are interested.

ST. LOUIS, MO.—The formal opening of the Midland division of the St. Louis Transit Company's system of electric railways in St. Louis County was celebrated last week by an official trolley party. At Creve Coeur Lake a banquet was held.

JERSEY CITY, N. J.—The Ridgefield & Teaneck Railway Company has been organized. The incorporators are James C. Young, of Jersey City; Armitage Mathews, of New York, and George E. Spencer, of Brooklyn. The capital stock is $500,000.

DALLAS, TEXAS.—George T. Bishop and J. B. Coffinbury, of Cleveland, Ohio, have formed a company and are at work securing a right of way for an electric line between Fort Worth and Dallas. They expect to spend about $700,000 on the road.

ST. LOUIS, MO.—The Olive Street Division of the St. Louis Transit Company's system will soon be equipped with handsome combination cars. The new cars will be made out of the present grip cars and trailers made over and combined into one.

FORT WAYNE, IND.—A meeting has been called to consider matters relative to the immediate organization of the Oil Belt Traction Company. This is the projected line to run from Huntington to Portland, via Bluffton. The construction will cost $600,000.

MARTINSVILLE, IND.—T. W. Newcomer, a capitalist, of Cleveland, Ohio, in company with Jesse Tarkington, of Indianapolis, has been in consultation with local capitalists concerning the building of the proposed electric road from this city to the State Capital.

WORCESTER, MASS.—The Warren, Brookfield & Spencer Street Railway has petitioned the railroad commissioners for an increase of $70,000 in its capital stock. The Bristol County Street Railway Company has petitioned for an issue of its original stock of $120,000.

MARION, IND.—The Marion Traction Company has petitioned the City Council for a franchise to the city limits on the West. The company proposes to build several suburban lines, with Marion as the centre. The extensions will be encouraged by the council.

MONTGOMERY, W. VA.—The Kanawha Traction & Electric Company has been incorporated here. Capital, $100,000. Incorporators, G. W. Champ, E. W. McCormick, M. J. Simms, B. H. Early, all of Montgomery; C. W. Dillon, of Fayetteville; E. W. McCormick, attorney.

BERKELEY, CAL., has granted the Oakland Railroad a franchise for an electric line through North Berkeley. It will be an extension of that company's Telegraph Avenue line via Bancroft Way and Oxford Street. Thirty days must elapse before the franchise becomes operative.

ST. LOUIS, MO.—The annual meeting of the stockholders of the St. Louis Car Company was held Feb. 13. The old board of directors was re-elected. The following officers were re-elected afterward: George J. Kobusch, president and treasurer; P. M. Kling, secretary and manager.

DAYTON, OHIO.—The Dayton & Troy Electric Railway Company will let contracts next month for the material for the construction and equipment of its road. This company was recently organized, with a capital of $300,000. It will build 22 miles of track, using 70-pound T-rail on the 18 miles in the country.

SKOWHEGAN, ME.—Negotiations have been opened between the owners of the Skowhegan & Norridgewock electric road and William H. Perry, of Boston, and George B. Boutwell, of Providence, for the purchase of the road. The new owners plan several extensions of the road.

CHATTANOOGA, TENN.—The negotiations looking to the consolidation of the street railways of Chattanooga have fallen through. There is now another deal on to consolidate the Lookout Mountain inclines, the Chattanooga Rapid Transit Railway and the Signal Mountain Railway.

EL PASO, TEXAS.—The Santa Fe Street Railway, of this city, a mule-car line, was sold under the hammer recently to satisfy a mortgage. It was knocked down to John T. Terry, of New York, for $34,000. It is the intention of the purchasers to convert the road into an electric line.

WASHINGTON, D. C.—The stockholders of the Washington & Rockville Electric Railway Company have elected the following board of directors: George Truesdell, George W. Young, Frederick C. Stevens, Henry D. Mirick, Thos. J. Hayward, George W. Bacon and Charles A. Lieb.

NEW BRUNSWICK, N. J.—Another link has been added to the trolley system controlled by the Whitney-Smith syndicate, in the through line across New Jersey. The Elizabeth & Westfield Company has purchased the Union & Middlesex Company's seven-mile line to Boynton Beach.

OSHKOSH, WIS.—The Traction Company, of this place, has been purchased by the Emerson-McMillin Company, of New York. There are over 30 miles of line all told, of which 13 are in this city. The sale also includes an electric plant, a park and a summer resort of 14 acres.

SEATTLE, WASH.—The Seattle-Tacoma Electric Railway Company's construction work at the Tacoma end is being vigorously prosecuted again after a delay of several weeks, owing to delay in receiving track material. It is proposed to build a rolling-lift bridge at the Puyallup River.

PHILADELPHIA, PA.—Christopher L. Magee, of Pittsburg, who has been stopping in this city for some time, confirms the reported consolidation of street railways of that city. The new Union Traction Company, for which a charter has already been asked, will represent over $15,000,000.

FRANKLIN, PA.—The transfer of the Franklin Electric Street Railway to D. J. Geary and associates of Oil City has been made and the new company reorganized. Work on the connecting line between Oil City and Franklin will take in Reno and other villages and will be pushed to completion.

CINCINNATI, OHIO.—One of the most important of the several projected railway lines in and about Cincinnati is the one to Coney Island, an up-river resort. A part of the line will be double-tracked. Connection with the Cincinnati Street Railway Company's lines would be at Tusculum in the east end.

OSHKOSH, WIS.—In the Winnebago County circuit court Judge Burnell denied the application of the Falk Company for a receiver for the Citizens' Traction Company, of Oshkosh. The solvency of the company was proved and nothing was shown by the plaintiff to indicate waste or mismanagement.

ST. LOUIS, MO.—The Circuit Court last week overruled the motion for a new trial made by the authorities of the City of Kirkwood, in the suit against the St. Louis & Meramec River Railroad, in which it was sought to prevent the railroad company from operating commercial cars on the streets of Kirkwood.

FREDONIA, N. Y.—The street railway company's temporary power house is ready for the new apparatus, which, as soon as it has arrived and been placed in position, will enable the company to resume business again. It will be remembered that the company's old power house was destroyed by fire some weeks ago.

WILMINGTON, DEL.—The Wilmington & New Castle Railway Company, of New Castle, Del., has completed plans for an extension to run from New Castle to Delaware City, and to cost $135,000. Estimates for construction materials, car barns, power house, electrical equipment, etc., will be taken by the company at once.

MILFORD, MASS.—The Milford, Holliston & Framingham Street Railway Company has passed into the hands of four New Haven capitalists—Israel A. Kelsey, J. Willes Downs, Winthrop G. Bushnell and John T. Monson. A. F. Mars, superintendent, is succeeded by E. H. Goss, president of the Middletown (Conn.) street railway.

BLOOMSBURG, PA.—Plans are completed for the building of the Columbia & Montour Electric Railway. The road will be 22 miles long and will extend from Danville to Berwick. The officials of the new company are: President, B. F. Myers, Harrisburg; treasurer, L. E. Waller, Bloomsburg; secretary, F. E. Miller, Bloomsburg.

ST. LOUIS, MO.—The new cars on the Eastern Avenue division of the St. Louis Rapid Transit Company present some new features in the interior arrangement and fittings. The incandescent lamps are placed along the sides, one above each alternate seat, and two registers are provided for recording cash, half fares and transfers.

OTTAWA, ONT.—Application will be made to the Dominion Parliament for an act to enable the Buffalo Railway Company to acquire the assets and franchises of the Niagara Falls Park & River Railway Company, the Clifton Suspension Bridge Company, the Queenston Heights Susnension Bridge Company, and the Queenston Heights Bridge Company.

COLUMBUS, OHIO.—The Columbus Freight & Traction Company was incorporated by W. D. Bickell, William D. Park, William D. Hamilton, Charles E. Morris and John W. Hamilton. The capital stock is fixed at $25,000. Organization was effected as follows: W. D. Pack, president; Charles E. Morris, vice-president, and John W. Mooney, secretary.

CLEVELAND, OHIO.—A Cincinnati syndicate has made an offer of $750,000 for the Toledo & Maumee Valley Traction Company and the Toledo, Bowling Green & Fremont Electric Railway Company. The object appears to be to connect these roads with the Cincinnati & Miami Valley Traction Company recently formed, which is now pushing northward to Lima.

BALTIMORE, MD.—The stockholders of the United Railways Company re-elected the old board of directors, and also President Perin and the present officers. The report of the president, covering the nine months of the existence of the company, showed a surplus of $42,000, after paying interest on the consolidated mortgage bonds and other fixed charges.

MANSFIELD, OHIO.—The Mansfield, Savannah & Wellington Electric Railway Company has secured the necessary franchises through Richland, Ashland and Lorain counties. By connecting with the branch of the Cleveland, Berea, Elyria and Oberlin Electric Railway, now being built to Wellington, this will give a complete line from Mansfield to Cleveland.

ST. LOUIS, MO.—A certificate of incorporation was issued Feb. 19 to the Lakeside Amusement Company of St. Louis. Capital, $15,000. Incorporators: William Jens, J. L. Meir and Charles P. Ochsner. This company is composed of the officers of the St. Louis Transit Company, and will conduct various amusement features at Creve Coeur Lake next summer.

NEW YORK, N. Y.—The Industrial Railway Company has just been organized in New Jersey. Its capital stock is $100,000, and its object is to manufacture machinery of all kinds and build, equip and operate "industrial and other railways." The incorporators are Henry McL. Harding, of New York, and Schuyler S. Wheeler and Charles M. Lowther, of East Orange.

PITTSBURG, PA.—The Pittsburg & Lake Erie Railroad Company has let the contract for the power house, which the company is building in connection with the new station. The contract for the entire engineering work has been given to Westinghouse, Church, Kerr & Co., and the electrical apparatus will be furnished by the Westinghouse Electric & Manufacturing Company.

RICHMOND, VA.—A bill has passed the state senate authorizing the consolidation of the Port Norfolk Electric Railway Company, the Portsmouth & Smithfield Railroad Company and the Portsmouth, Pigs Point & Newport News Railway, Ferry & Hotel Company into a corporation to be known as the Norfolk, Portsmouth & Newport News Railway Company, and to define its powers.

PITTSBURG, PA.—The general superintendent of the United Traction Company of this city, Mr. John Murphy, has about completed a map, which is an exact reproduction in miniature of all the street car lines under his supervision; and by this means he will be able to tell in his office at any time of the day or night where any of the cars of the company on the different lines are to be found.

GENEVA, WIS.—The Geneva Lake, Sycamore & Morris road will, when built, be the longest electric line in the world. It will extend from Morris, Ill., to Geneva, Wis., with branch lines to DeKalb and Belvidere, Ill. The principal offices will be in Sycamore, Ill. The company has a capital of $150,000. Work will begin immediately after the reception of the incorporation papers.

BUFFALO, N. Y.—The International Traction Company is preparing for heavy traffic during the Pan-American year. An order has been placed with the J. G. Brill Company, of Philadelphia, for 100 open cars. Fifty closed cars are in the course of construction at the Cold Spring shops, and it is stated that 150 cars will be built later. Where the latter equipment will be constructed has not yet been decided.

GALVESTON, TEXAS.—Under a foreclosure decree in favor of the Guaranty Trust Company, of New York, and the United States Mortgage & Trust Company issued by the federal court, the Galveston City Street Railway, with its franchises and appurtenances, was again sold. There was only one bidder, Charles E. Hitchkiss. He only made one bid, $905,000, and the property was knocked down to him at that price.

NEW BRUNSWICK, N. J.—The Brunswick Traction Company, the New York & Philadelphia Traction Company and the New Brunswick City Railway Company have been consolidated as the Somerset & Middlesex Traction Company. Gottfried Krueger, of Newark, is president of the company; Andrew H. Radel, of Bridgeport, Conn., is vice-president, and Edward H. Radel, of this city, is secretary and general manager.

INDIANAPOLIS, IND.—The board of public works held a conference during the week with the representatives of interurban electric lines asking franchises to enter Indianapolis. The board informed the representatives that it was the purpose of the city to secure cash remuneration for the franchises on the basis of gross receipts, or a per cent. of the fares collected, or annual payment of a lump sum into the city treasury.

PITTSBURG, PA.—The plan to connect Pittsburg and Cleveland by a trolley road is now being rapidly pushed. Capitalists from this city and Cleveland have held a number of meetings lately, and another meeting will be held. Joshua Rhodes and Francis Torrens, of this city, are interested in the scheme. The Cleveland City Street Railway Company and the United Traction Company, of this city, are interested.

NEW ORLEANS, LA.—The shareholders of the New Orleans City Railroad Company have re-elected the following directors: R. E. Craig, C. H. Hyams, F. T. Howard, J. B. Levert, A. B. Wheeler, R. M. Walmsley, Albert Baldwin, J. C. Denis and John C. Russell. Subsequently the directors met and elected the following officers: R. M. Walmsley, president; Albert Baldwin, vice-president; A. H. Ford, secretary and treasurer; C. D. Wyman, general manager.

TOLEDO, OHIO.—The stockholders of the Toledo, Tiffin & Sandusky Electric Railway Company elected the following named officers: George D. Loomis, president; B. W. Wilson, vice-president; J. F. Bunn, secretary, and Richard Young, treasurer. George D. Loomis and Charles J. Yingling, of Tiffin, Ohio, and S. B. Hege, Richard Young and R. W. Brown, of Washington, D. C., were chosen directors. All of the necessary right of way has been secured for this road.

PORTSMOUTH, N. H.—At a meeting of the stockholders of the Portsmouth, Kittery & York Electric Railway it was voted to increase the capital stock $30,000, the same to be expended in the purchase of a ferryboat to run between this city and Badger's Island; to build the extension from York Beach to St. Aspinquid Park; to connect with the Atlantic Shore electric road from Biddeford, and for the erection of a storage battery at York Beach to run the extension. The extension to St. Aspinquid Park will be the connecting link of a line of electric roads from Boston to Portland.

NASHUA, N. H.—The Mont Vernon & Milford Electric Railway has been organized. Franklin Marden, of Mont Vernon, has been chosen president, and A. L. Keyes, secretary and treasurer. The directors are Franklin Marden, Clark Campbell, W. I. Blanchard, Mont Vernon; A. H. Barber, George E. Gates, F. E. Maley, W. B. Rotch, John McLane, Milford; John H. Spalding, Nashua; George A. Marden, Lowell, Mass.; W. B. Clarke, Dr. Pettingill, Mr. Hobart, Amherst. The road will run through Mont Vernon, Amherst and Milford and eventually it may be continued to this city.

OSHKOSH, WIS.—It is rumored that the Citizens' Traction Company has been purchased by the Emerson McMillin Company, of New York. The bulk of the stock of the company is owned by George J. Hobusch, of the St. Louis Car Company, and Otto W. von Schroeder, also of St. Louis. The sale also includes a power plant, a park and summer resort of 14 acres less than two miles south of the city, also a substation and a park on the interurban line nine miles north of the city. It is understood that the new company has planned extensive improvements and that the interurban line will probably be extended north and west.

MILWAUKEE, WIS.—At the annual meetings of the Milwaukee Electric Railway & Light Company and the Milwaukee Light, Heat & Traction Company on Feb. 19, General Manager John I. Beggs was chosen a director in place of A. Marcus, of New York City. Other officers and directors were all re-elected as follows: President, William Nelson Cromwell, of New York; vice-president, Henry C. Payne, of Milwaukee; secretary, C. A. Spofford, of New York; assistant secretary, F. H. Whitney, of Milwaukee; treasurer, George R. Sheldon, of New York; assistant treasurer, George O. Wheatcroft, of Milwaukee; directors, W. W. Cromwell, S. W. Burt, Charles Spofford, C. N. Wetmore, New York; Henry C. Payne, Charles F. Pfister, Frank G. Bigelow and John I. Beggs, Milwaukee. The same officers and directors were elected for both companies, which control electric traffic and illumination in Milwaukee, Racine, Waukesha and neighboring places.

ST. LOUIS, MO.—The returns of the street railways of the city for the last quarter of 1899, ending Dec. 31, are as follows: St. Louis Railway Company, Broadway cable, embracing those of the Baden and St. Louis and the Southwestern divisions, 241,020 trips, 3,468,845 passengers; St. Louis Transit Company, embracing the Bellefontaine, Cass Avenue, Citizens', Compton Heights, Laclede, Missouri, Norma City, Northern Central, Southern Electric, Taylor Avenue, Union Depot and Vandeventer Avenue divisions, 1,317,132 trips, 25,179,443 passengers. People's Railway Company, 45,720 trips, 829,677 passengers; St. Louis & Suburban, embracing the Manchester and the St. Louis & Meramec River divisions, 54,542 trips, 3,305,674 passengers. Totals, 1,658,315 trips and 32,783,639 passengers. The returns for the year ending Dec. 31, 1899, by quarters is as follows: First quarter, 1,340,244 trips, 27,326,810 passengers; second quarter, 1,326,337 trips, 32,227,686 passengers; third quarter, 1,195,751 trips, 31,745,483 passengers; fourth quarter, 1,658,315 trips, 32,783,639 passengers. Totals for year, 5,520,641 trips, 124,083,618 passengers.

THE AUTOMOBILE.

THE SANDUSKY AUTOMOBILE MANUFACTURING COMPANY, of Sandusky, Ohio, has applied for a charter. It will make a new gasolene automobile.

STRIKE AGAINST AUTOMOBILES.—All the cabmen of Naples, Italy—numbering not far from 10,000—have struck in an endeavor to prevent the introduction of automobile cabs, as proposed by their employers.

THE CONSOLIDATED MOTOR VEHICLE COMPANY has been incorporated, with headquarters at East Orange, N. J. The capital is $1,000,000. The incorporators are John W. Moaker, James S. Garvin and C. Frederick Smith.

THE ELECTRICAL DEVELOPMENT COMPANY, of Wilmington, Del., has been incorporated to build and operate electric vehicles. Capital, $200,000. Incorporators, E. T. Canby, N. C. Haughey, G. W. Kimball, all of Wilmington.

HAMILTON, ONT.—The National Cycle & Automobile Company, which has recently commenced the manufacture of bicycles, automobiles, etc., in this city, intends operating its works by electricity supplied by the Cataract Power Company.

A ROYAL AUTOMOBILE.—The Prince of Wales has joined the ranks of the motorists. He has ordered a 6-hp Daimler phaeton car for four passengers, to be delivered at Sandringham, and the Prince himself intends to take lessons in its management.

THE KERN AUTOMOBILE TRANSPORTATION COMPANY, Kern, Cal., was recently incorporated with a capital stock of $25,000. Directors, H. E. Sweetser, L. F. Champion, L. J. Whyers, G. G. Hutchings, J. Sanderson, W. V. Matlock, J. W. Shaffer, Alvin Fay.

THE PARRY MANUFACTURING COMPANY, Indianapolis, Ind., has definitely decided to erect a new automobile factory southeast of the city. A variety of automobiles will be manufactured. Mr. Parry says he hopes to be able to enter the market next year on an extensive scale.

THE INTERNATIONAL ANDERSON MOBILE COMPANY has been chartered at Charleston, W. Va., to deal in automobiles. The capital is $2,000,000, and the incorporators are G. E. Morris, G. W. Walmuth, A. F. Bouton, W. Fleming and C. F. Thompson, all of New York City.

NEW YORK CITY is to have a big automobile show at the Grand Central Palace, Nov. 10 to 24, under the management of Mr. Marcus Nathan. Floor space will be cheap and "extras" will be cut. A big success is expected. Not less than 100,000 square feet of floor space will be available.

THE OLD DOMINION MOTOR & CARRIAGE COMPANY has applied to the Richmond (Va.) city council for a franchise to run automobile vehicles in the streets and parks. Those interested in the company are Andrew Pizzini, Jr., J. H. Carlisle, Albert Davis, V. G. Robinson, J. P. Evans and others.

THE WINSLOW MOTOR CARRIAGE COMPANY has been incorporated at Dover, Del. Capital, $300,000. Incorporators, A. S. Winslow, H. F. Ambler, J. G. Crasswell, all of Philadelphia.

DELAWARE.—The Electrical Development Company, of Wilmington, which purposes to deal in electrical and other vehicles, has been incorporated at Dover, Del., with a capital stock of $200,000.

AMESBURY AUTOMOBILES.—A special despatch from Amesbury, Mass., of Feb. 21, says: A New York automobile company has placed an order for automobiles, to be delivered at the rate of 30 per day for six months. This is the biggest order ever received in this carriage town and will aggregate a half-million of dollars.

THE CHICAGO AUTOMOBILE COMMISSION is examining applicants for permission to operate automobiles in Chicago. One employee of the Illinois Electric Vehicle Transportation Company was refused a license because he was color blind, and could not distinguish between green and red colors. Fifty applications for licenses have been made. Each operator is required to pay a license fee of $3 for the first year and $1 for each succeeding year.

AUTOMOBILE HOUSES.—An enterprising English firm builds to order houses for automobiles. They are portable houses, of light construction, quickly erected at any point, and have a neat appearing exterior. For a small runabout a house 6 by 8 feet has been designed. The sides are paneled and the interior lined with felt. The floor is raised slightly from the ground, and a hinged board at the door, turned in when the door is closed, forms an incline to run the automobile in on.

THE NATIONAL AUTOMOBILE & ELECTRIC COMPANY, Indianapolis, Ind., headed by L. S. Dow and H. C. Newby, has been incorporated with a capital stock of $250,000. The incorporators and directors are L. S. Dow, H. T. Hearsey, Philip Goetz, Robert Martindale, A. E. Metzger, A. C. Newby and C. E. Test. Mr. Dow has been elected president and Mr. Goetz, secretary of the company. The company has bought a tract of land and commodious buildings will be erected at once. Seven distinct types of electric vehicles are to be made, largely from designs by Mr. Dow.

NEW INDUSTRIAL COMPANIES.

BRANTFORD, ONT.—A large and well-known firm of manufacturers of electrical instruments and dynamos, whose headquarters are in the United States, propose to establish a Canadian branch at Brantford.

THE ACME ELECTRIC COMPANY, of New York City, has been incorporated to manufacture and sell electrical apparatus. Capital, $25,000. Directors, George H. Crosman, Louis A. Jackson, Charles Secor, New York City.

TRENTON, N. J.—The Berlin Manufacturing Company has been incorporated in New Jersey with a capital stock of $200,000, to manufacture railroad cars, street cars, trucks and wheels, etc. It will build a factory in New Jersey.

THE EAGLE WIRE MANUFACTURING COMPANY, of Chicago, has been incorporated for the purpose of manufacturing electrical appliances and supplies. Capital, $2500. Incorporators, F. G. Jones, Emma I. Ilg, J. W. Dunson, all of Chicago.

THE CONSOLIDATED ELECTRIC LAMP COMPANY, Kittery, Me., has been incorporated with a capital of $100,000. Incorporators, F. S. Moynahan, of Danvers; N. A. Moynahan, of Cambridge; C. W. Gould, of Chelsea; M. M. Merritt, of Middletown; O. G. Berry, of Boston, Mass.

THE DURHAM TELEPHONE MANUFACTURING COMPANY, of Durham, N. C., has been incorporated, with a capital of $12,000, for the purpose of manufacturing telephones, switchboards and electrical appliances. The incorporators are Julian S. Carr, George W. Watts and L. A. Carr, all of this place.

THE CHEATHAM ELECTRIC SWITCHING COMPANY has been incorporated at Louisville, Ky. The company will manufacture and sell a patent electric switching device for railroads. The capital stock is $70,000. The incorporators are A. B. Cheatham, Peter Arlund, C. P. Todd and H. T. Sutton, all of Louisville.

LEGAL.

CABLE CUTTING.—At New Haven, Conn., on Feb. 26, the Commercial Cable Company secured $5000 damages from W. H. Bailey, whose schooner fouled the company's Atlantic cable.

TELEPHONE PROTECTIVE APPARATUS.—We are informed that the Court of Appeals at Washington, D. C., has just rendered a decision for the plaintiff (Frank B. Cook) in the case of Cook vs. Western Electric Company, in the matter of complete protective system for telephone apparatus.

THE NATIONAL SUBWAY COMPANY, ST. LOUIS.—In the case of the National Subway Company, of St. Louis, against the city of St. Louis, to recover $3000 alleged to have been paid for a franchise which was not granted, Circuit Judge Wood, on Feb. 19, decided in favor of plaintiff. Plaintiff held that the ordinance allowing it to operate was passed in 1889. The Supreme Court ordered the permit issued.

EDUCATIONAL.

WORCESTER POLYTECHNIC INSTITUTE.—The thirtieth annual catalogue of the Worcester Polytechnic Institute, Worcester, Mass., for 1900 contains 200 pages. It includes a brief history of the institute and a general plan of its organization and method of instruction. Registers of graduates and students, variously classified, are also given.

COLUMBIA SCHOOL OF MINES.—Profs. Henry S. Munroe and Henry M. Howe, of the School of Mines, Columbia University, are sending out circular letters soliciting contributions to the fund to increase its equipment and endowment, for which $300,000 is asked. The university officials will be grateful for any co-operation in the effort to raise this fund for extending the usefulness of the School of Mines. The appeal is endorsed by many well-known business and professional men, and by many of the alumni of the school.

THE PRESIDENCY OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—Rear Admiral William T. Sampson was recently offered the position of president of the Massachusetts Institute of Technology, to succeed President James M. Crafts, but declined the honor. In speaking of the matter Admiral Sampson is reported to have said: "It would mean my leaving the service with which I have so long been identified and entering upon a new life for which I am probably less fitted than for the one which I now hold. While I appreciate the honor conferred upon me, and while as a matter of fact such a change would mean increase in salary, at my time of life the change is not to be thought of."

UNIVERSITY OF ILLINOIS.—The State University Bulletin of Feb. 10 of the University of Illinois is devoted to a description of the purposes and equipment of the College of Engineering at that university. The electrical engineering laboratory contains, in its equipment, various types and sizes of direct and alternating current dynamos, motors and rotary converters, and all of the necessary apparatus for making individual and complete tests of them. Special transformers are provided for all classes of work in poly-phase testing and of capacities adapted to the laboratory requirements. There are also a standardizing laboratory and photometry rooms, and the university electric lighting and power plant is available for tests by the department.

THE AMERICAN SCHOOL OF CORRESPONDENCE, situated in Boston, is claimed to be the only correspondence school in the country making a specialty of steam, electrical and mechanical engineering. A careful inspection of the school's instruction papers convinces one of the painstaking thoroughness and accuracy which distinguishes the work of this New England institution. The school is chartered by the commonwealth of Massachusetts, and enjoys the respect and confidence of thousands of earnest students throughout the United States. The instructors are all graduates of leading scientific schools, and have had valuable experience along engineering lines. The courses have been carefully laid out by prominent educators and engineering experts. They embrace every subject required by the up-to-date engineer and mechanic in order to have complete mastery over the theoretical details of his daily work. The school was founded to give high grade instruction to those men who have been compelled by adverse circumstances to leave school at an early age, in order to earn a living. With this idea in view, the tuition has been purposely placed very low so that no wage-earner shall be debarred from receiving the benefit of such a course. By taking advantage of the school's generous offer, the ambitious mechanic can receive a thorough technical education in his profession by merely devoting his spare moments to systematic home study. A postal card addressed to the American School of Correspondence, Boston, Mass., will procure a handbook, describing its methods, and letters from graduates giving results of their experience.

PERSONAL.

MR. TRUMAN HIBBARD, general manager, Willow River Electric Light & Power Company, Hudson, Wis., is in the east on an extended tour of inspection among the leading electrical plants.

MR. F. S. HUNTING, treasurer and sales manager of the Fort Wayne Electric Works, Fort Wayne, Ind., is making a tour of inspection of the company's branch offices, and was in Cincinnati last week.

CAPT. G. O. SQUIER, U. S. V., of the Signal Service, has an interesting article in a recent "Independent" on the Pacific cable, a branch of work and study to which he has been specially assigned by the government.

MR. A. H. PATTERSON, of the Phoenix Glass Company, has gone on an extended trip through Texas, Mexico and California, taking in the Mardi Gras festival at New Orleans on the way. He expects to be away a couple of months.

LIEUT. BRADLEY A. FISKE, of the U. S. S. Petrel, which took an active part in the famous battle of Manila Bay, has returned home to enjoy promotion and a well earned rest after three years' service in the Far East and the Philippines. He will make his residence in New York City and resume electrical investigations.

MR. S. FRANK ALDEN, who has charge of the electric light plant of the city of Tacoma, Wash., announces his engagement to Miss Frances Wolbert, of that city. Mr. Alden is a native of Fair Haven, Mass., and has been engaged in the operation of central station and gas properties for some years, in behalf of a Boston syndicate, placing these plants on a profitable basis.

OBITUARY.

MR. GEORGE LABRAM.—A despatch from Milwaukee, says: George Labram, maker of the gun "Long Cecil," whose death is reported from Kimberley, was a Milwaukee man. He was educated as a mechanical engineer, but gave most of his time to electrical work. Several years ago he went to South Africa and became consulting engineer to the De Beers Company, in whose service he proved so valuable a man that when the war broke out he was getting a salary of $18,000 a year. Last summer, apprehending a conflict with the Transvaal, he sent his wife to America. Labram was 40 years old. He was a friend of Cecil Rhodes, and in the letters which he sent home, he expressed a firm conviction of the justice of the British cause.

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Trade Notes.

THE JONES BROTHERS ELECTRIC COMPANY, of Cincinnati, Ohio, has increased its capital stock from $220,000 to $264,000.

THE FEDERAL INSTRUMENT COMPANY, Albany, N. Y., report that they are using several Woodward & Rogers drilling machines, which are giving excellent satisfaction.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., will be glad to send a copy of its lamp and transformer catalogue to anyone in the electrical field who has not as yet been supplied.

FUSE WIRE.—The Chicago Fuse Wire & Manufacturing Company, 154 Lake Street, Chicago, Ill., in catalogue No. 11 gives prices, illustrations and useful data of its tested fuse wire and links.

ALBERT & J. M. ANDERSON MANUFACTURING COMPANY, of Boston, Mass., have recently completed an extensive addition to their factory. They are just moving from the overcrowded condition of the old factory.

THE ELECTRICAL APPLIANCE COMPANY, Cincinnati, O., has issued a neat little circular calling attention to a new telephone just put on the market. It is intercommunicating, direct line, and may be used in multiple or series.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, 572 First Avenue, New York, has issued a four-page folder in which are pointed out the good points of the G. I. incandescent lamps manufactured by the General Incandescent Lamp Company, Cleveland, Ohio.

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati, reports four or five good sized orders for direct connected units. One was from Armour & Co., of Chicago. Orders were also received for some machines to go abroad through the company's New York sales agents.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has closed a contract to supply a complete three-phase electric transmission plant for the Mammoth Collins Mines in Arizona. It will be a water power plant of several thousand horse-power capacity.

THE ROYAL ELECTRIC COMPANY, Peoria, Ill., in a bulletin just issued, describes and illustrates the construction of its type E transformers. The principal merits of the transformer are also described. Type E Royal transformers are made in 13 sizes, ranging from 500 watts to 25,000 watts capacity.

THE MONTHLY BARGAIN SHEET of the Gregory Electric Company, Chicago, for March, is just out from the press, and as usual is full of interesting information. Forty pages are required to contain all the items about the numerous pieces of apparatus described. It is sent free on application.

THE L. A. MEYER COMPANY has been incorporated in Milwaukee, Wis., to carry on electrical business. The officers are: L. A. Meyer, president; A. Peterman, superintendent of electric work, and L. Jorgensen, secretary and treasurer. The company is located at 450 East Water Street, Milwaukee.

THE N. N. HILL BRASS COMPANY, of East Hampton, Conn., have one of the most complete plants for the manufacturing of bells in this country. They have an abundant supply of water for power purposes throughout the year; 20,000 square feet of floor space, and a capacity of over 30,000 bells a day.

PASS & SEYMOUR will on March 1 move their Chicago office from the Monadnock Block to the Plymouth Building. Mr. John W. Brooks, sales agent, states that he will have larger and better shipping facilities in the new quarters, and will be able to carry a larger stock of P. & S. electrical specialties.

THE CENTRAL VALVE ENGINE.—The M. C. Bullock Manufacturing Company, Chicago, has brought out an interesting pamphlet describing the central valve high speed engine manufactured by it. The descriptive matter is written up in a chatty style, being interspersed with illustrations, diagrams, etc.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, Scranton, Pa., have issued a circular containing a sketch of the origin and growth of the correspondence method of instruction, views of the building, pictures of the faculty and of some of the students, and describes briefly every course taught by the schools. It makes interesting and instructive reading.

MESSRS. GREENE, TWEED & CO., 17 Murray Street, New York, have issued an illustrated catalogue of the "Improved" Rochester automatic lubricators for stationary engines, marine engines, steam pumps, locomotives and hydraulic elevators. This lubricator starts and stops with the engine or pump, and feeds oil of any consistency.

THE BALDWIN LOCOMOTIVE WORKS, Philadelphia, Pa., in a pamphlet giving a "record of recent construction," shows two electric mine locomotives. These engines have capacities of 70-hp at a speed of 8 miles per hour on a level, and 100-hp at the same speed. The dimensions of the engines illustrated in the pamphlet are given in two languages—English and French.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, has issued Bulletin No. 32a, in which the construction and features of the type "H" belted direct current multipolar motor are described, and illustrated in detail. Efficiency curves of a 20-hp and a 250-hp type H motors are given, and various tables giving the sizes and dimensions of this line of machines.

W. E. FAN MOTORS for 1900 are described and illustrated in an attractive catalogue just issued by the Western Electric Company, Chicago. The line includes battery fans and desk and ceiling fans for both direct and alternating current. The various styles are illustrated, and sectional views show the features and details of construction. Price lists of the fan motors are also given.

MESSRS. SIPE & SIGLER, Cleveland, Ohio, have closed a contract with the Indiana Bicycle Company, of Indianapolis, for its season's supply of batteries. Heretofore the Indianapolis concern has manufactured its own batteries, but after experimenting with Sipe & Sigler's Willard battery it was found to be cheaper and superior to anything that could be produced in the company's own factory.

THE CLING-SURFACE MANUFACTURING COMPANY, of Buffalo, N. Y., report that they have received several letters recently from users of Cling-Surface, which bear out a claim they have made for their material: that as it penetrates oily dynamo belts the oil is forced out before the Cling-Surface and can be wiped off the outside of the belt. The Cling-Surface takes its place in the belt, which is what they instruct their customers it will do. They report business advancing steadily, both in home and branch offices.

THE GEORGE C. TOWLE MANUFACTURING COMPANY, of Lancaster, Pa., report that the month of February has been an exceptionally busy one in their power motor department. They are having a large demand for their neat new illustrated catalogue of fans and motors, which can be had for the asking. Their factory is running night and day hurrying a large stock of fans to completion for the coming summer season.

THE OSBORN ELECTRIC MANUFACTURING COMPANY, 294 Dearborn Street, Chicago, has issued a neat folder giving information regarding Federal battery salt and Federal batteries. It is handling these products. Federal battery salt gives 33 per cent. more current and 33 per cent. longer life to all batteries. This is a result that deserves attention. The Osborn Company is also sending out a price list of National incandescent lamps in barrel lots. It contains some attractive figures.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., announce that they have a very large stock of structural material, consisting of beams, channels, angles, etc., in stock at East Berlin, Conn., and consequently are able to furnish on very short time steel bridges, buildings, roof trusses, etc As this class of material is very difficult to obtain at the present time, it may be of interest to some of our readers who contemplate additions to their plant to communicate with the Berlin Iron Bridge Company.

MOLONEY ELECTRIC COMPANY, St. Louis, Mo., manufacturers of the well known Moloney transformer, announce that they will send, on request, to any central station of financial responsibility in the United States, one of their Type A transformers, charges prepaid, with the understanding that the transformer may be returned within 30 days at the company's expense if it is not satisfactory. The Moloney Company feel satisfied that if anyone will make a severe and exhaustive test of their product the result of the test will lead to business.

THE LAWTON-BEATTIE COMPANY, Cincinnati, Ohio, has installed complete electric equipments in some half-dozen or more mercantile establishments during the past 10 days. One contract just completed with the American Type Foundry Company was for 40 motors; another good sized one was for the Cincinnati Regalia Company—a light service—and another for the extensive Cincinnati house of May, Stern & Co. The company has also just installed a switchboard at the printing establishment of the Spencer & Craig Company for the distribution of power throughout the establishment.

VENTILATION AND HEATING.—Joseph McCreery & Son, manufacturers of the McCreery cooling, cleansing, heating and ventilation system, have been very successful in placing the system aboard vessels, a number of the large shipbuilders of the United States having installed it aboard new ships. It is claimed that either for buildings or ships the temperature of the air by this system may be reduced in summer by one to fifty degrees, and raised to any desired temperature in winter. In addition the air is cleansed of all impurities, while its humidity remains the same in wet, dry or hot weather.

GENERAL ELECTRIC TRADE LITERATURE.—We have recently received from the General Electric a batch of new trade literature. It includes an artistically designed and executed pamphlet on alternating current fan motors, "flyers" on G. E. porcelain knob insulators and direct current enclosed arc lamps for interior illumination; price lists of commutator segments and brushes for Brush arc generators and of porcelain cutouts for 125 and 250 volts. Two bulletins are also included in the lot, No. 4213 on horizontal edgewise instruments, and No. 4214 on motor controllers for power and mining machinery. The pamphlet, bulletins and flyers contain illustrations of the subjects treated.

THE BROWN & SHARPE MANUFACTURING COMPANY, Providence, R. I., has just issued a new edition of its catalogue. The catalogue has been thoroughly revised, and contains 460 pages. The large number of tables that it contains makes it especially valuable to the workman as a book of reference. The principal additions this year to the machines and tools regularly manufactured by this company are automatic cutting-off machine, automatic screw machine, automatic turret forming machine, circular milling attachment, geared pump, high speed milling attachment, high gauge, key seat rule, lathe mandrels, micrometer calipers, plain grinding machines, quill gear cutting attachment, rack cutting attachment, screw pitch gauges, self-oiling friction pulleys, surface gauges, tempered rules with end graduations, tools for screw machines, also new designs of milling machines. These catalogues are mailed upon application free to any address.

THE MODERN TELEPHONE & SUPPLY COMPANY, which was recently formed in Chicago to engage in the manufacture of high grade telephones and supplies, is enjoying well merited prosperity in the telephone field. It is not half a year ago since this company was organized by Mr. William Hauptman and George E. Cowen on a comparatively small but practical basis, and it is interesting to observe how rapidly this company, in its mere infancy, is advancing. From the day it announced its opening and acquainted the trade with the skill and perfection of its instruments it has been running its factory night and day. Orders are daily increasing. The field covered extends to Canada, Jamaica, New Zealand, etc., and the reports the firm receives from its distant customers are very encouraging. The company is personally managed by Mr. William Hauptman, who is a practical telephone electrician with a wide experience, and is closely watching the interests of the business. As a practical telephone expert he is quick to improve his products in both efficiency and design and spares no pains to make them as perfect as possible. Among recent improvements is one on the solid back transmitter, which dispenses with the front screws that hold the inner carbon cup. This enables a better construction. The sale of these instruments is said to be rapidly increasing. The company, which is located at 56 Fifth Avenue, Chicago, Ill., has just issued a special bulletin with many attractive offers and will cheerfully send a copy to any address upon request.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED FEB. 20, 1900.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, Times Building, N. Y.]

643,618. FIRING APPARATUS; E. B. Babbitt, United States Army. App. filed July 19, 1899. The recoil of a gun is used to compress a spring which afterward drives a magneto-electric generator to supply current for firing the primer.

643,649. APPARATUS FOR CONTROLLING ELECTRIC MOTORS; J. J. Heilmann, Paris, France. App. filed Nov. 8, 1899. (See Current News and Notes.)

643,666. SIGNAL SYSTEM FOR RAILWAYS; K. W. Mansfield and W. R. Thompson, South Norwalk, Conn. App. filed April 6, 1899. The trolley wire is fitted with extra contact devices with which the trolley wheel engages to close the signaling circuit. The invention consists of the peculiar arrangement of levers and electromagnets in the signal box whereby the lights are covered and uncovered.

643,706. TELEGRAPHIC SAFETY DEVICE; S. R. Wright, of Morton, N. Y. App. filed Dec. 11, 1897. In case an operator leaves the key open a magnet in the main circuit after a predetermined interval closes a local circuit and sounds an alarm.

643,722. THERMOSTAT; C. E. May, of Dunedin, N. Z. App. filed Nov. 14, 1898. A length of wire is put under tension and upon it is suspended a contact device which, when the wire is heated and expanded, lowers and completes an alarm circuit.

643,730. ELECTRIC SWITCH; W. T. Pringle, of Primos, Pa. App. filed July 19, 1899. A modification of the quick action switch.

643,742. CONDUIT SYSTEM FOR ELECTRIC RAILWAYS; L. Dion, Boston, Mass. App. filed July 2, 1897. A closed conduit having a cover capable of electrical conductivity, a main conductor enclosed therein and an auxiliary conductor superimposed on the main conductor and composed of independent disconnected sections, each of the sections being free to rise and fall under the action of an electromagnet carried by the vehicle.

643,744. ELECTRIC HEATER; G. C. Hawkins, Boston, Mass. App. filed March 13, 1899. This is a casing containing the coils of an electric heater, a fan and an electric motor for driving the fan. The air is drawn through the heating apparatus and then sent out into the compartment to be heated.

643,758. STARTING BOX AND CONTROLLER FOR ELECTRIC MOTOR; F. R. Blake, Boston, Mass. App. filed Dec. 8, 1899. The construction consists of a rack bar having contact fingers which co-operate with the resistance plates, a retarding device for the rack bar which controls its movement in one direction, a weight for moving the rack bar in its retarded direction and connections whereby the rack bar is moved in the opposite direction by the means employed for operating the circuit switch of the motor.

643,801. ANTISEPTIC MOUTHPIECE; M. Martin, Boston, Mass. App. filed June 2, 1899. The mouthpiece is provided with a veneer consisting of a compound of guncotton, ether, alpha-naphthol and alcohol, which sets rigidly from a plastic condition and is moisture-proof when set.

643,810. CONTRIVANCE FOR AVOIDING COLLISIONS OF TRAINS; C. Burian, of Bucharest, Hungary. App. filed Sept. 25, 1899. Structural details relating to a system wherein when two trains enter or are upon the same block, steam will be cut off from both engines and the brakes applied.

643,823. MOTOR ACTUATED SIGNAL MECHANISM; T. B. Keeler, Rahway, N. J. App. filed March 10, 1899. An electric motor is placed in a box on the pole with the semaphore and is controlled by two circuits.

643,824. MOTOR ACTUATED SIGNAL; T. B. Keeler, Rahway, N. J. App. filed May 10, 1899. An improvement on the preceding by which it is intended to provide for the automatic movement of the actuating device to a position where it will be ready for prompt action when the signal is to be set to "safety." It also provides for locking the signal against unintentional movement.

643,830. TELEPHONE TRANSMITTER; A. Stromberg, Chicago, Ill. App. filed Nov. 10, 1899. (See page 325.)

643,834. ELECTRIC ARC LAMP; C. J. Toerring, Philadelphia, Pa. App. filed July 18, 1899. The lamp comprises a top plate, a supporting tube secured thereto, a cap plate attached to the lower end of the supporting tube, a small globe fitted airtight to the cap plate, a carbon-carrying tube passing substantially airtight through an aperture in the cap plate and a clutch carried by the tube.

643,854. ELECTRIC MOTOR WHEEL; J. T. Whittlesey, Elizabeth, N. J. App. filed June 26, 1899. A motor wheel for self-propelling vehicles in which the web of the wheel between the hub and rim is utilized as a portion of the magnetic circuit to thereby reduce the weight of the field magnets and save the space which would otherwise be occupied by them.

643,864. AUTOMATIC RETURN SIGNALING DEVICE FOR TELEPHONES; F. Burger, Fort Wayne, Ind. App. filed May 3, 1899. (See page 325.)

643,865. CONTROLLER FOR ELECTRIC AUTOMOBILES; C. G. Burrows, Windsor, Conn. App. filed Nov. 15, 1899. The object of this invention is to provide a simple, durable and easily operated controller so constructed that a quick make and break can be made without any possibility of stopping the contacts in positions where arcs will be established.

643,872. ILLUMINATED SIGN; C. H. Hill, Williamsport, Pa. App. filed June 1, 1899. Behind the transparent face of the sign a number of variously colored lamps are mounted to be rotated so that the sign will appear intermittently in different colors.

643,880. THERMOSTATIC APPARATUS; L. Morgan Stern, Gottingen, Germany. App. filed June 21, 1899. Two columns of mercury are balanced against each other and each subjected to air pressure which is varied by the temperature. When the pressure of the air on one side overbalances that on the other, the mercury is shifted, causing a closure of circuits which either sends in an alarm or operates a damper.

643,898. DENTAL OVEN; H. M. Hill, St. Louis, Mo. App. filed Jan. 23, 1899. The crucible is provided externally with spiral grooves in which heating conductors are located; it is then packed in a casing containing non-heat conducting material.

643,905. VALVE-OPERATING MECHANISM; A. N. Locke, Salem, Mass. App. filed Oct. 17, 1899. The invention in this valve-closing device, resides more especially in the mechanical arrangements, they being merely under the control of an electro-magnet operable from a distance.

643,993. TELEPHONE TRANSMITTER; C. E. Tucker and L. S. Jenkins, York, Pa. App. filed May 23, 1899. (See page 325.)

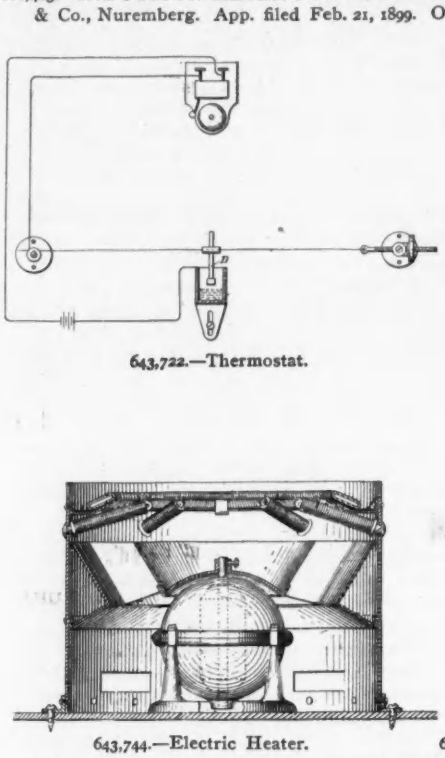
644,029. PROCESS OF ELECTRODEPOSITION OF METALS; S. O. Cowper-Coles, London, England. App. filed Aug. 28, 1899. (See Current News and Notes.)

GERMAN PATENTS, ISSUED FEB. 7, 1900.

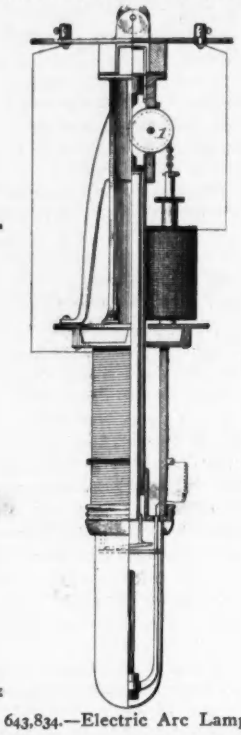
[In Charge of Dr. Ralph Julian Sachers, 120 Liberty Street, New York.]

106,423. INDUCTION METER FOR POLYPHASE CURRENTS; Schuckert & Co., Nuremberg. App. filed Feb. 21, 1899. One coil in lead I. co-operates with a coil placed between lead III. and a point *o*; another coil in lead III. co-operates with a coil placed between lead II. and the point *o*, the latter being connected to lead I. by means of a choke coil.

643,722.—Thermostat.



643,744.—Electric Heater.



643,834.—Electric Arc Lamp.

106,677. LIGHTNING ARRESTER; C. Schmidt, Mannheim. App. filed Feb. 18, 1898. A ring connected to one wire of the line is provided on the inside with propeller-shaped blades; the other wire is connected to a bearing in which a propeller wheel is located, which by its rotation produces ever-changing points of discharge, the distance for the discharge remaining always the same.

106,678. SOCKET FOR INCANDESCENT GLOBES; Heinrich Gethe, Berlin. App. filed Aug. 26, 1898. Two spring bolts act upon two lever clutches, the ends of which engage into recesses pressed in the foot-end of the glass globe whereby the sealed-in wires for the filament are kept separated and firmly secured.

106,682. SYNCHRONISM INDICATOR FOR SHUNT CONNECTION OF TWO ALTERNATING CURRENT SOURCES; Schuckert & Co., Nuremberg. App. filed March 24, 1899. The two sources placed in parallel produce in two ring coils, *A* and *B*, two magnetic fields rotating in opposite direction. By the co-operation of the two fields, a closed ring or drum coil, *C*, is acted upon in such a way as to indicate the relative frequency between the two fields, by the successive flash of a suitable number of lamps branched off of coil, *C*. It will also show the difference between the periods and the moment of coincidence of the phases. The same result may be obtained by having the ring coils, or even all three coils, arranged upon the same core. In place of the two ring coils, a single coil may be used, being fed at three different points by the three-phase currents of the two machines, the incandescent lamps being arranged at three points of the same coil located diametrically opposite the feed points.

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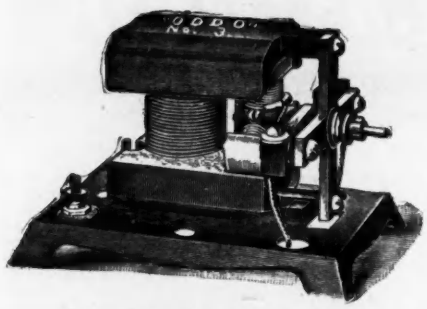

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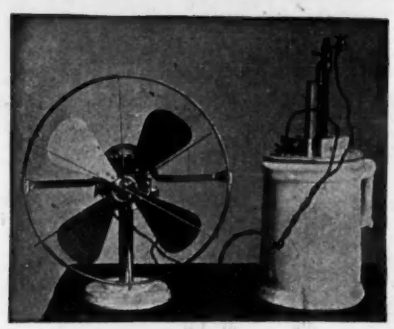

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1	12-light		S. Thresher s. o., 75 volt.
1	16	"	Commercial s. o., new arm't.
1	25	"	Edison s. o.
1	35	"	Duplex s. o., 75 volts.
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1	55	"	Edison s. o.
1	70	"	Western Electric s. o.
1	75	"	T.-H., new, s. o.
1	160	"	Rockford.
1	200	"	Howard, new arm't.
1	200	"	Am. Engine Co. M. P., s. o.
1	250	"	Commercial s. o.
1	300	"	Loomis.
1	300	"	Eickmeyer.
1	340	"	Eddy s. o.
1	350	"	Columbia M. P. s. o.
2	350	"	Hawkeye comp.
1	350	"	Jenney s. o. comp., new arm.
1	350	"	National s. o. comp.
1	360	"	Rockford s. o. comp.
1	400	"	Wood M. P. s. o., comp.
1	450	"	Rockford.
1	450	"	Holtzer Cabot s. o., new arm't.
1	540	"	Edison, oil cup, 30-kw.
5	540	"	Edison, s. o., 30-kw.
1	550	"	E. & C., multipolar, s. o.
1	600	"	Eickmeyer.
1	800	"	Rockford, s. o., new arm't.
4	800	"	Edison, 45-kw, s. o., comp.
1	1300	"	Waddell-Entz, 80-kw, for direct connection.

220-VOLT GENERATORS.

1	7	K. W.	Jenney.
1	10	"	T.-H., s. o.
1	12	"	Westinghouse.
1	20	"	Commercial, s. o.
1	25	"	Holtzer-Cabot, s. o., new arm't.
1	45	"	Edison, s. o.
1	60	"	Edison.
1	75	"	Wood M. P., s. o.

500-VOLT GENERATORS.

1	17	K.W.	Card, self-oiler.
1	25	"	Rockford, self-oiler, new, comp., Manchester type.
1	25	"	Edison, self-oiler.
1	25	"	Commercial, s. o.
1	25	"	T.-H., s. o., comp.
1	25	"	Gen. Elec., M. P., s. o.
1	30	"	Jenney, s. o.
1	35	"	Jenney, s. o.
1	40	"	T.-H., s. o.
2	45	"	Edison, comp., s. o.
1	60	"	K. W. Edison, comp., s. o.
1	60	"	Sprague, new arm't, s. o.
1	75	"	Westinghouse M. P., s. o.
1	80	"	Crocker-Wheeler, s.o., M.P.
1	100	"	Commercial, s. o., comp., M. P., new armature.
1	500	"	Gen. Elec., M. P., comp., new armature, s. o.

ARC DYNAMOS.

1	6-light	2000-cp	T.-H., with extra armature.	
1	20	" 1200	" Excelsior, s. o.	
1	20	" 2000	" W. Electric.	
1	30	" 2000	" Standard.	
2	30	" 2000	" W. Electric.	
1	30	" 2000	" Brush No. 7.	
2	35	" 2000	" T.-H., L. D. 2.	
1	35	" 2000	" T.-H., L. D. 2, ring arm't.	
2	35	" 2000	" Wood American.	
1	40	" 2000	" Wood.	
3	40	" 2000	" W. Electric.	
6	45	" 1200	" Brush No. 7.	
3	45	" 1200	" T.-H., M. 12.	
1	45	" 1200	" T.-H., M. 12, ring arm't.	
1	50	" 2000	" Excelsior, latest type.	
1	50	" 1200	" Standard.	
1	50	" 1200	" T.-H., L. D. 12, s. o., ring arm't.	
2	50	" 1200	" T.-H., L. D. 12, s. o., new, ring arm't.	
1	50	" 1200	" T.-H., L. D. 12, s. o., ball arm't.	
1	50	" 2000	" Wood American.	
1	50	" 2000	" Brush No. 7½.	
2	50	" 2000	" T.-H., M. D., ball arm't.	
1	50-light	2000-cp	T.-H., M. D., self-oiler, ring arm't.	
1	60	" 2000	" W. Electric, s. o.	
1	60	" 2000	" Westinghouse, s. o., toothed arm't, with exciter, 6 pole.	
4	65	" 2000	" Brush.	
1	75	" 2000	" Westinghouse, s. o. toothed armature, direct current, with exciter, 6 pole.	
2	75	" 1200	" Wood, No. 8, Ft. W.	
3	125	" 1200	" Excelsior, latest type.	

ALTERNATING GENERATORS.

2	350-light		Thomson-Houston, self-oilers, composite wound, with exciters.
1	500	"	Bain, 30-kw, self-oiler, new arm't, 15,000 volts, with exciter.
2	600	"	Thomson-Houston, A. 6, 15,000 alt., 1100 volts, complete with exciters.
1	600	"	Thomson-Houston, 30-kw, 2 phase, 1100 volts, 15,000 alt., complete, with exciter.
1	650	"	Thomson-Houston, A. 35, composite wound, 15,000 alt., 1100 volts, with exciter, s. o.
2	750	"	Westinghouse, s. o., 16,000 alt., 1100 or 2200 v., 37½ K.W., with exciter.
1	750	"	National, 1100 volts, 16,000 alt., with exciter.
1	900-light		Westinghouse, 1100 volts, 16,000 alt., latest type, slotted armature, composite, with exciter.
1	1000	"	National, 1100 v., 16,000 alt., new arm't, with exciter.
1	1000	"	Wood, 50-kw, s. o., 1100 v., latest type, 16,800 alt., toothed arm't, composite wound.
1	1200	"	National, s. o., 1100 or 2200 volts, toothed armature, 16,000 alt., with exciter.
2	1200	"	T.-H., A. 12, with exciter, 1100 v., 15,000 alt.
1	1200	"	Westinghouse, 60-kw, s. o., toothed arm't, 1100 v., 16,000 alt., latest type, composite wound, with exciter.
1	1200	"	Gen. Elec., A. 60, 1100 volts, 15,000 alt., toothed armature, composite wound, latest type, with exciter.
1	1300	"	Westinghouse, 110 volts, 16,000 alternations, complete, with exciter.
2	1300	"	Thomson-Houston, A. 70, 1100 v., 15,000 alternations, self-oiler, composite wound, complete, with exciter.
1	1300	"	Thomson-Houston, A. 70, 2000 volts, 15,000 alternations, self-oiler, composite wound, complete, with exciter.
1	1300	"	Slattery, self-oiler, 1000 or 2000 v., 16,000 alt., with exciter.
2	300	"	Westinghouse, 150-kw., self-oiler, 1100 volts, 16,000 alt., with slotted armature, compensating field, complete, with exciter.
2	6000	"	Westinghouse, 300-kw, 1100 volts, 16,000 alt., latest type, toothed armature, composite wound, self-oiler, out board bearings, complete, with exciter.

110-VOLT MOTORS.

1	¼	H. P.	C & C.
2	1	"	Belding.
1	1	"	Roth, new arm't.
1	?	"	T.-H., s. o.
1	1	"	Commercial, new, s. o.
1	2	"	Edison, s. o.
1	2	"	Duplex, s. o.
1	3	"	Westinghouse.
1	3	"	Jenney.

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1, 300 KW. SIEMENS-HALSKE 2000 VOLTS, 8000 ALTERNATIONS, DIRECT CONNECTED TO GREENE TANDEM COMPOUND ENGINE.
2, 240 KW., 2-PHASE STANLEY, 380 R.P.M., WITH ENGINES, DIRECT CONNECTED.
2, 300 Kw. Westinghouse single-phase, iron clad toothed armature.
1, 150 Kw. Monocyclic General Electric, 2200 volts, 60 cycles.
1, 120 Kw. Westinghouse single-phase, 2000 volts, iron clad toothed armature.
2, 120 Kw. Westinghouse, 1000 volts, iron clad toothed armature, single-phase.
2, 75 Kw. Westinghouse two-phase, 2000 volts, low frequency.
1, 60 Kw. Westinghouse two-phase, 2000 volts, low frequency.
1, 60 Kw. Westinghouse single-phase, 1000 volts, low frequency, iron clad toothed armature.
1, 45 Kw. Westinghouse single-phase, 1000 volt, low frequency, iron clad toothed armature.
1, 30 Kw. Westinghouse single-phase, 1000 volt, iron clad toothed armature.
1, 240 Kw. single-phase General Electric, 1000 volts, high frequency, toothed armature.
2, 120 Kw., 2000 volts, General Electric, toothed armature.
2, 120 Kw., 1000 volts, General Electric, toothed armature.
2, 90 Kw. General Electric, 1000 volts, toothed armature.
2, A-70 T.-H., 1000 volts.
2, A-60 General Electric, 1000 volts, toothed armature.
2, A-35 T.-H., 1000 volts.
2, A-30 General Electric, 1000 volts, toothed armature.
2, 150 Kw. Stanley, two-phase, 2000 or 1000 volts.
2, 60 Kw. Stanley, two-phase, 2000 or 1000 volts.
2, 150 Kw. Ft. Wayne, 2000 or 1000 volts, single-phase, latest type.

(110 Volts.)

2, 100 Kw. direct connected units, consisting of 1 Straight Line engine and 2 50 Kw. General Electric, 6-pole generators, one generator on either side of the engine.
1, 100 Kw. Siemens & Halske direct connected to straight line engine.
1, 75 Kw. Siemens & Halske, direct connected to Ames engine.
1, 60 Kw. 6-pole Westinghouse direct connected to Ames engine.

We have Edison bi-polar machines ranging from 150 Kw. to 10 Kw.

1, 500 Ampere, Mp., Onondaga.
2, 75 Kw. Mp., General Electric.
1, 12 Kw. Lundell, Mp.
1, 4 Hp., C & C.

We have a lot of brand new Excelsior dynamos, ranging in sizes from 75 Kw. down, which we acquired with the Excelsior factory, and which will be sold very cheap.

DIRECT CURRENT MOTORS AND GENERATORS. (220 Volts.)

2, 75 Kw. Westinghouse Mp., direct connected to Westinghouse engines.
1, 75 Kw. General Electric, direct connected to Ideal engine.
1, 80 Kw. Excelsior Mp., direct connected to Russell engine.
1, 150 Hp., 4-pole Westinghouse.
1, 100 Kw., 220-volt Edison.

DIRECT CURRENT MOTORS. (500 Volts.)

1, 50 Hp. Thomson-Houston, D-50.
1, 45 Kw. Edison.
1, 40 Hp. Westinghouse multipolar, 950 r.p.m.
1, 40 Hp. Crocker-Wheeler.
1, 30 Hp. Westinghouse, multipolar, moderate speed.
1, 30 Kw. Belknap.
1, 25 Hp. Crocker-Wheeler multipolar.
1, 15 Hp. Keystone, slow speed, 600 r.p.m.
1, 15 Hp. General Electric multipolar, moderate speed.
1, 12 Kw. Edison.
2, 10 Hp. General Electric multipolar, moderate speed.
1, 10 Hp. Mather
2, 60 Kw. Edison.
1, 30 Hp. Westinghouse.
2, 15 Hp. Eddy.

Also brand new Excelsior machines of all sizes, at secondhand prices.

DIRECT CONNECTED RAILWAY UNITS.

2, 800 Kw. General Electric, 80 r.p.m., direct connected to Allis cross-compound engines.
2, 400 Kw. General Electric, 100 r.p.m., direct connected to Harrisburg tandem engines.

RAILWAY GENERATORS.

2, 500 Kw. General Electric M.P.
2, 500 " Westinghouse M.P.
2, 110 " General Electric M.P.
2, 100 " Westinghouse M.P.
2, 300 " General Electric M.P.
2, 250 " Westinghouse M.P.
2, 200 " Westinghouse M.P.
1, 150 " Walker M.P.
2, 150 " Edison bi-polar.
2, 100 " Edison bi-polar.
2, D-62 bi-polar, T.-H.

ARC DYNAMOS.

1, 165-Light, 1200 c.p. Brush.
2, 120-Light, 1200 c.p. Brush.
2, 125-Light, 2000 c.p. Brush.
2, 125-Light, 2000 c.p., latest type Fort Wayne.

ENGINES.

22 in. x 40 in. x 48 in. Tandem Compound Harris.
26 in. x 60 in. Harris Corliss.
22 in. x 42 in. Wright Corliss.
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14 in. x 13 in. Armington & Sims.
13 in. x 13 in. Armington & Sims.
10 in. x 12 in. Watertown.
150-Hp. Westinghouse Compound.

BOILERS.

2, 250-Hp Sterling Water Tube.
2, 150-Hp. Sterling Water Tube.
10, 72 in. x 16 ft. Return Tubulars
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4, 42 in. x 90 ft. Sacks.
1, 600-Hp. Nordberg Condenser.

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1	3	"	Bain.
1	4	"	Edison, s. o.
1	5	"	Western Elec., s. o.
1	5	"	T.-H., newly rewound, s. o.
1	10	"	Triumph, s. o.
1	12	"	Am. Eng. Co., M. P., s. o.
1	12	"	Rockford.
1	14	"	Howard, new arm't.
1	18	"	Commercial, s. o.
1	20	"	Loomis.
1	20	"	Eickmeyer.
1	24	"	Eddy, s. o.
2	25	"	Hawkeye.
1	25	"	Rockford, s. o.
1	25	"	Jenney, s. o., new arm't.
1	25	"	National.
1	25	"	Columbia, M. P., s. o.
1	30	"	Wood, M. P., s. o.
1	30	"	Rockford, s. o.
1	30	"	Holtzer-Cabot, new arm't.
5	35	"	Edison, 30-kw, s. o.
1	35	"	E. & C., M. P., s. o.
1	40	"	Eickmeyer.
2	60	"	Edison, 45-kw, s. o.

220-VOLT MOTORS.

3	1	H.P.	Sprague, self-oilers.
1	1	"	Edison, ¾-kw, self-oiler.
2	1	"	Ahlm Edwards, new M. P. slow speed.
3	1	"	Eddy, s. o.
1	1½	"	Holtzer-Cabot, s. o.
1	1¾	"	Gen. Elec., M. P., s. o.
1	2	"	Jenney, s. o.
1	3	"	Belding, M. P.
1	3	"	Crocker-Wheeler, slow sp., s. o.
3	3	"	General Electric, type I. B., slow speed, new.
1	3	"	T.-H., self-oiler.
2	3	"	Card, slow speed, s. o.
1	5	"	Akron, self-oiler.
1	5	"	T.-H., self-oiler.
1	5	"	C & C. self-oiler.
1	5	"	General Electric, M.P., s. o.
1	7½	"	Ft. Wayne, Jenney.
1	7½	"	Eddy, self-oiler.
2	7½	"	Edison, self-oiler.
1	12	"	T.-H., self-oiler.
1	15	"	Westinghouse, s. o.
1	15	"	Sprague.
1	15	"	Card, M. P., s. o., new.
1	20	"	C & C.
1	25	"	Commercial, M. P., s. o.
1	30	"	Holtzer-Cabot.
1	60	"	Edison, 45-kw, self-oiler.
1	75	"	Edison, 60-kw, self-oiler.
1	100	"	Wood, s. o., M. P.

500-VOLT MOTORS.

1	¼	H.P.	Crocker-Wheeler, s. o.
1	1	"	Commercial, s. o.
1	1	"	Jenney, s. o.
1	1	"	Eddy, s. o.
2	1	"	Crocker-Wheeler, s. o.
1	3	"	Toledo, s. o.
1	3	"	Jenney, s. o.
1	3	"	T.-H.
2	3½	"	Rockford, iron clad.
1	7½	"	Wood, s. o.
1	15	"	Nowotny, s. o.
2	18	"	C & C, new am't, s. o.
1	20	"	Commercial, s. o.
1	20	"	Triumph, s. o., iron clad.
1	20	"	Card, s. o.
1	25	"	Mather, ring type.
1	30	"	T.-H., s. o.
1	30	"	Commercial, s. o.
1	30	"	Gen. Elec., M. P., s. o.
1	30	"	Rockford, self-oiler, new.
1	30	"	Edison, 25-kw, self-oiler.
1	35	"	Jenney, self-oiler.
1	40	"	Jenney, self-oiler.
1	50	"	T.-H., D. 40, s. o.
1	60	"	Edison, 45-kw, self-oiler.
1	75	"	Edison, self-oiler.
1	75	"	Sprague, s. o., new arm't.
1	100	"	Westinghouse, M. P., s. o.
1	105	"	Crocker-Wheeler, M. P., s. o.
1	135	"	Commercial, M. P., s. o.

ALTERNATING CURRENT MOTORS.

1	⅛	H.P.	Holtzer Cabot, 133 cycle, single phase.
1	¼	"	Ft. Wayne, 133 cycle, single phase.
2	¼	"	Stanley, 133 cycle, single phase.
2	½	"	Stanley, 133 cycle, single phase.
1	1	"	Ft. Wayne, 133 cycle, single phase.
1	1	"	Westinghouse, 133 cycle, single phase.
1	2	"	Wagner, 60 cycle, single phase.
1	2½	"	Ft. Wayne, 133 cycle, single phase.
1	5	"	Ft. Wayne, 133 cycle, single phase.
1	5	"	Wagner, 60 cycle, single phase.
1	15	"	Wagner, 60 cycle, single phase.
1	3	"	Westinghouse, 60 cycle, two phase.
1	10	"	Gen. Elec., s. o.

3-phase type, 8—10—900.
Form A, 60-cycle, 110-volt.

ARC MOTORS.

1 2 H.P. Excelsior.
1 3 " Brush, 9.6 amp.

RAILWAY MOTORS.

3 W. P. 30. Practically new.

MOTOR-GENERATORS.

1 3 K.W. Edison, self-oiler, 500-60 volts, 6-50 amperes.

RAILWAY—220 VOLTS.

2 T.-H., F. 6, motors, for railway or crane work.
1 Factory truck, complete, with two F. 6 motors, standard gauge.

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20 " " " "
30 " " " "
50 " " " "
90 " " " "
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150 " 2000-50 " "
300 " 1050-115 or 230 "
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12-light 1000-50 or 100 volts.
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20 " 2000-50 "
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30 " 1000-50 "
30 " 1000-50 or 100 volts.
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100 " " " "
125 " " " "
125 " 1000-50 "
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3 25 K.W. Edison 125-volt.
1 40 K.W. C & C 500-volt.
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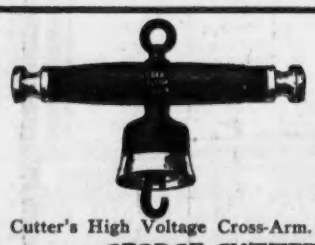
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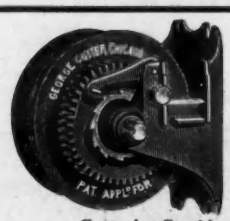

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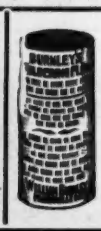

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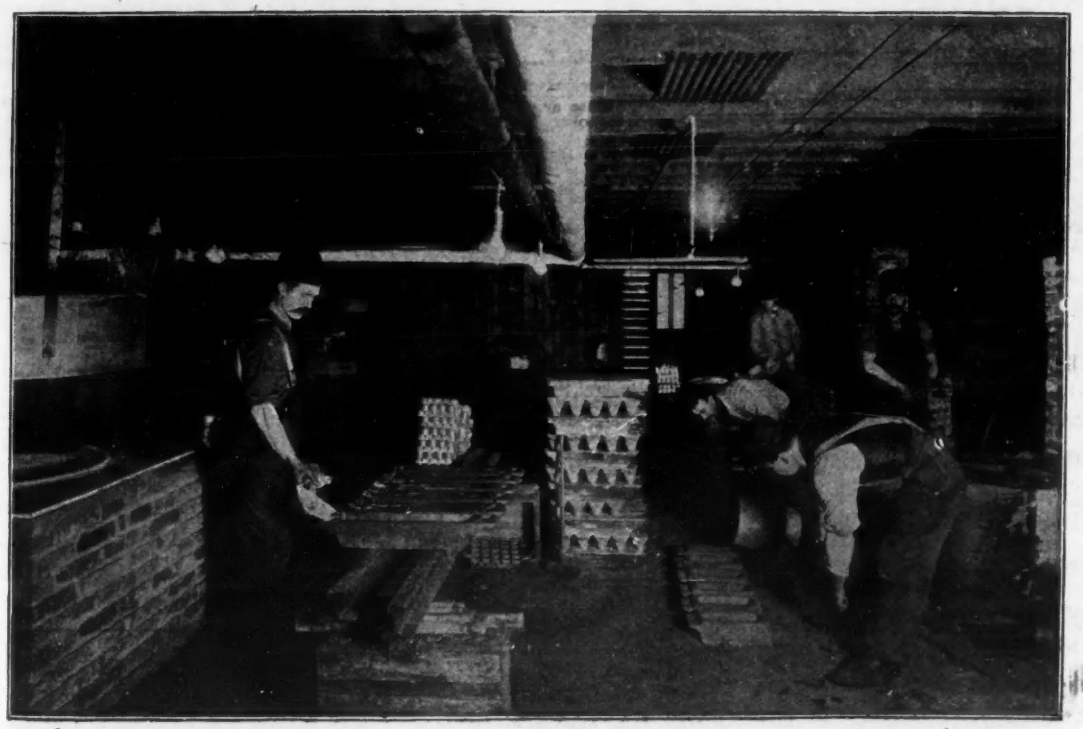

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1—35 H.P. Sprague M.P., 500 volts.
1—30 H.P. Eddy M.P., 500 volts.
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50 " Eddy.
50 " C & C.
75 " National.
100 " Edison.
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540 " Edison.
1, 800 " Edison.

500 VOLT GENERATOR
1, 45 K. W. Edison.

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220 VOLT MOTORS.
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2, 3 " Eddy.
1, 3 " Connecticut.
6, 3 " C & C.
1, 3 " Keystone.
1, 5 " Excelsior.
1, 7½ " Westinghouse
1, 15 " Edison.
1, 15 " Perrett.
1, 20 " Eddy.

500 VOLT MOTORS.
1, 1 H. P. T.-H.
1, 3 " C & C.
1, 12 " C & C.
1, 18 " T.-H.
1, 60 " Edison.

110 VOLT MOTORS.
1, ¼ H. P. Sprague.
1, ¾ " Edison.
1, 2 " Gibbs.
1, 2 " Wagner.
1, 3 " Eddy.
1, 3 " C & C.
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1, 7½ " Edison.
2, 15 " Edison.
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All Machines Guaranteed to be in Good Operative Condition.

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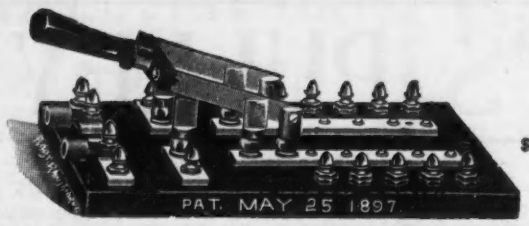

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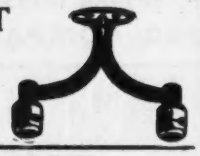

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